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UMI
A case-control study to determine the risk factors, markers and determinants for the development of nursing caries in the four-year-old population of North York.

By

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A thesis submitted in conformity with the requirements for the degree of Master's of Science, Graduate Department of the Faculty of Dentistry, University of Toronto.

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Abstract

Nursing caries is a distinctive pattern of severe tooth decay seen in infants and toddlers. Improper infant bottle feeding habits are considered to be the most frequent cause of this condition, however it has also been reported in children who have used sweetened pacifiers and those that reportedly were breast-fed exclusively. The purpose of this study was to examine if socio-cultural and behavioural factors were related to the development of nursing caries in the child population of North York. This would assist dental public health managers to developing appropriate health promotion and disease prevention strategies for those families with children at the greatest risk for the development of nursing caries. A total of 3,310 four-year old children from 151 schools were screened. There were 281 nursing caries cases identified. Of these 192 (68 per cent) were active cases, and 89 (32 per cent) were treated cases. Data were collected using a self completed questionnaire that was mailed-out, using a three-stage technique. The final sample analyzed contained 71 active cases, 29 treated cases and 107 control children. Eight variables were found to be statistically significantly related to the development of nursing caries in this study population; dental knowledge, frequency of brushing, maternal birthplace, child's birthplace, family income, dental insurance, use of dental services, and the primary source of child care information. When the data were examined using logistic regression, four risk factors were found to be important with respect to the development of nursing caries in the four-year-old population of North York; dental knowledge, use of personal sources of child care information, dental service utilization by the child's father and lack of workplace insurance. The results of this study support the hypothesis, that there are socio-cultural and behavioural factors related to the development of nursing caries, which could be addressed through public health efforts.
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1. Introduction

Nursing caries is a distinctive pattern of severe tooth decay seen in infants and toddlers. This pattern of decay has been referred to by many names, including 'Baby Bottle Tooth Decay', 'Nursing Bottle Syndrome' and 'Nursing Bottle Caries'. Presently there is an increase in the utilization of the terms 'Early Childhood Caries' and 'Infant Feeding Caries', however the term 'Nursing Caries' (NC) is the one most frequently used by the dental scientific community. Improper nursing bottle habits are considered to be the most frequent cause of this condition, however it has also been reported in children who have used sweetened pacifiers or who have been exclusively breast-fed (Ripa, 1988). What is unclear is why parents continue to practice behaviours which have been widely recognized as potentially harmful.

The purpose of this study was to examine the socio-cultural and behavioural factors related to the development of nursing caries in the child population of North York. We intend to establish a data-derived hypothesis regarding the risk factors, markers and determinants for NC in the North York population, and therefore aid dental public health managers develop appropriate health promotion and disease prevention strategies for those families at the greatest risk for the development of nursing caries. Our working hypothesis was that the development of nursing caries in the child population of North York was associated with the following risks: aberrant feeding habits, low maternal education, low family income, and low parental knowledge. These factors were chosen as they were previously cited in the literature, as well as being found to be potentially significant in the pilot project for this study. We chose the
case-control methodology, as it represented the most efficient means of concurrently examining several potential etiological factors for development of this type of decay.

1.1 Public Health Importance

The World Health Organization (WHO) defines health as "the complete state of social, emotional and physical well-being, not merely the absence of disease or infirmity" (WHO, 1978). The 1986 Ottawa Charter on Health Promotion, proclaimed that health was a resource for daily living (WHO, 1986). Oral health, like general health contributes to personal well-being and the quality of life. Dental health should be a concern for anyone interested in the well being of children. Although dental caries seldom is life threatening, it may be debilitating, painful, expensive to treat, and in some cases may contribute to long-term sub-optimal health (Holst and Kohler, 1975).

Ace and Lodolini (1992) looked at the effect of Nursing Caries on children's body weight. When compared with a control group, the children with Nursing Caries were found to weigh significantly less. Ten per cent of the study group were found to weigh less than 80 per cent of their ideal body weight for their age. This was sufficient to categorize them as failing to thrive.
Four other potential sequelae to this type of decay are:

- poor speech development;
- decreased facial aesthetics;
- malocclusion, due to space loss;
- lack of guidance for the permanent teeth

(Nainar, 1990).

The cost of nursing caries is significant both in financial and human terms. The costs incurred by individual families should be considered from two perspectives: the financial burden placed on the family and the emotional costs of a child requiring treatment for nursing caries. The child with this type of decay usually requires complicated dental treatment, in a hospital, under general anaesthetic, as these children are often too young to be treated in a conventional office setting.

1. The financial costs to the individual families involved include:

1) The direct cost of the dental services: The average cost of treating one child with this condition ranges from $700.00 to $3,000.00,
as most children require multiple extractions and restorations.

2) The cost of transportation to and from the treatment facility: The treatment of these children usually occurs in a hospital setting. Families from small urban centres or rural areas may have to come to a larger centre to get treatment. The cost of this travel, possible hotel bills and other expenses can be considerable.

3) The cost to care for other siblings: Other children in the family require supervision while their parents attend to the affected sibling who is out of town, or in the hospital for treatment.

4) Lost earnings for the parent(s): The parent(s) of the child may have to attend several appointments for the treatment of this child's decay. For several people this time taken from work will result in lost wages which may not be recouped.

2. The emotional costs to the child and family include:

1) The effects of prolonged pain, from decaying and pulpally involved teeth, on a small child may be significant. The child may also suffer from emotional distress related to the unfortunate
cosmetic sequelae of extensive decay and extraction of the primary teeth.

2) The parents of these children may experience guilt feelings when it is realized that their neglect or poor parental judgement caused their child this amount of distress and exposure to the potential risks of treatment.

3) Both the parent and young child may experience anxiety regarding the use of a general anaesthetic. The child will be understandably anxious about being in a hospital with strangers, and the accompanying pain and discomfort involved in their treatment. The parents may be anxious about the safety of the procedures involved and the potential for anaesthetic accidents during the procedure (Winder, 1990). In Ontario there have been five reported cases of children suffering significant morbidity from anaesthesia for dental treatment (unpublished data).

The Children In Need Of Treatment Program (C.I.N.O.T.) was introduced in 1987 by the Province of Ontario. This program provides dental care to children from pre-school through grade eight if they are in immediate need of care. Only those families with no dental coverage are eligible, and parents must sign a declaration that the cost of dental treatment would result
in financial hardship to them. The C.I.N.O.T. program does not provide preventive services, or ongoing care. Only treatment for urgent conditions such as pain, infection, trauma or large open carious lesions is provided. Treatment for the sequelae of nursing caries is covered by this plan (Ministry of Health for the Province of Ontario, 1987).

Figures 1 and 2 are from the City of North York C.I.N.O.T. data base for 1992. They demonstrate that although nursing caries accounts for only a small number of claims (Figure 1), they are the most expensive claims (Figure 2).

1.2 Definition and Clinical Features of Nursing Caries

The term Nursing Bottle Mouth (NBM) has been attributed to Fass (1962), who was one of the first to consider that milk in a bottle could be the cause of rampant decay in children. He distinguished NBM from the usual form of rampant decay by the fact that in NBM the lower primary incisors remained unaffected (Fass, 1962). The severity of the caries was related to the age of the child and the teeth effected corresponded to the eruption sequence of the primary teeth (excluding the lower anteriors). In a 1988 review, Ripa explains that the syndrome previously referred to as NBM should truly be called Nursing Caries. This is because of reports of children with this pattern of decay who have been exclusively breast-fed, with no other deleterious feeding habits reported. The role of breast-feeding in NC has remained contentious within the dental community as well as among groups devoted to the increased use of breast-feeding as the sole means of infant nutrition (Abbey, 1979). The term Nursing Caries
could also be inappropriate if the condition were found to be unrelated to a child's feeding habits. An example of this would be decay caused from the frequent consumption of sugar containing medications.

Nursing caries has several distinctive features:

1) Many teeth are involved;

2) Lesion development is very rapid;

3) Caries occurs on surfaces usually considered to be at low risk for decay;

4) The lower primary incisors are rarely affected;

5) The teeth are affected depending on their sequence of eruption, the maxillary primary incisors are the most severely affected as they are among the first to erupt and therefore are subjected to the longest caries attack (Ripa, 1988).
1.3 Proposed Mechanism of Nursing Caries Development

When a baby sucks, the nipple (of the breast or bottle) rests against the palate, while the tongue covers the lower teeth. The liquid bathes all of the teeth therefore except the lower incisors. If the liquid contains a fermentable carbohydrate, it can be metabolized by plaque bacteria to produce acid capable of demineralizing teeth. When the fluid is consumed frequently or for long periods of time, it will pool around the teeth. In this stagnant environment, carious lesions develop rapidly. In advanced cases the crowns of the teeth may be completely destroyed leaving only root stumps (Ripa, 1988).
2. Literature Review

2.1 Prevalence and Risk Factors for Nursing Caries

2.1.1 Historical References

Although the term nursing caries or baby bottle tooth decay is relatively recent, the clinical entity, its aetiology, treatment and prevention have been discussed for literally hundreds of years. The Journal of the American Medical Association, 1981 contains a letter written by a father in 1652 describing the severe dental decay experienced by his four year old son. He notes that "four of his foremost teeth on the upper part of his mouth began to fade when he was about three quarters old." Although the nursing bottle was not in use at this time, children were offered a home made pacifier called a sugar bag, which was made from cloth and soaked in honey or molasses (Cone, 1981).

Darby, wrote in 1883 that the teeth of children do not receive the attention that they require. Most children of that time did not receive any dental care until approximately the age of ten years. He felt that poor oral health contributed to gastric troubles in children due to their inability to chew properly. He suggested that it was unnecessary for anyone to suffer from toothache in that "enlightened day ". Darby wrote that decay in the young child was due to parental ignorance and lack of attention (Darby, 1883). Cushing (1883) considered pre-natal influences to be important on the development of the teeth.
Pitts (1927) stated that "there are few sights so tragic as to see a child of two years or even less with teeth so carious that extraction is the only remedy". He felt that this was a "striking comment "on the failure of dental prophylaxis and revealed the need for preventive dentistry. Dr. Pitts performed one of the first epidemiological studies to examine the causes of nursing caries. He studied a population of 74 children who attended The Great Ormond Street Hospital for dental treatment. He examined the children and interviewed the mothers regarding the child's feeding history, the use of a "dummy " and the condition of the teeth on eruption. The mothers were also questioned regarding their pregnancy and delivery. He estimated the prevalence of caries in three year olds to be 26 per cent. He could find no difference in prevalence between bottle-fed and breast-fed infants and documented a case of caries in a 15 month old who was still being breast-fed. Of the 74 children, 43 were using a pacifier dipped in some fermentable solution and 2 mothers reported using a sugar bag. Pitts also examined teeth from forty of these children microscopically to determine if there were any enamel or dentin abnormalities which may have contributed to the caries experience in these children. Pitts concluded that one half of the cases he studied could be explained by dietary factors, one quarter by hypoplasia and the final quarter could not be explained (Pitts, 1927).

2.1.2 Prevalence

Although many studies have been conducted in an attempt to determine the prevalence of nursing caries, the results vary (See Table 1). The main difficulty in establishing an accurate
prevalence figure is the relative unavailability of pre-school aged children for examination. Because the clinical examination of an infant can be difficult, and the criteria used to diagnose nursing caries variable, the prevalence may be under-reported. Because infant feeding habits are strongly influenced by cultural and ethnic factors, data from one country or specific cultural group may not readily be extrapolated to another (Ripa, 1988).

As discussed previously one of the first studies reporting the prevalence of nursing caries was the 1927 report by Pitts. Since that time several studies have been done all over the world to examine the prevalence of this type of decay. In his review, Ripa (1988) summarized the prevalence figures obtained in 15 different studies of nursing caries. Various researchers have found the prevalence of this type of decay to be less than 5 per cent in most Western societies studied (Ripa, 1988).

There have been several studies done in Canada to determine the prevalence of Nursing Caries. In Vancouver, a 1982 survey found the prevalence to be 3.2 per cent in this non-fluoridated community (Derkson, Ponti, 1982). This prevalence is higher than reported for other preventable childhood illness such as rubella, mumps, measles, bacterial and viral meningitis and Hepatitis B (McIntosh et al., 1991). In the Canadian Inuit population of the Northwest Territories the prevalence of nursing caries was found to be 55 per cent by 30 months of age and 65 per cent by 48 months of age (Albert et al., 1988). This level of disease is typical of North American Native groups. A prevalence of 50.2 per cent was found in a Native American Head Start population (Cook et al., 1994) (See Table 1)
2.1.3 Risks Associated With Nursing Caries

As with many diseases, the aetiology of nursing caries is multi-factorial requiring the interplay between biological, environmental and socio-cultural factors.

a) Biological Factors

Studies have shown that for any type of decay to occur the bacteria Streptococcus mutans and Lactobacillus acidophilous must be present in large numbers at the site of decay. These bacteria can only colonize the mouth if teeth are present (Newbrun, 1989). Studies by Van Houte et al. (1982) and Milnes and Bowden (1985) have demonstrated the heavy colonization of the upper anterior teeth by S. mutans in children with NC. They found that S. mutans is the predominant type of bacteria associated with carious lesions in children with NC, and that the concentration of micro-organisms was high in both saliva and plaque. Van Houte et al. (1982) found that S. mutans accounted for over 50 per cent of the cultivatable flora in the mouths of children with NC. These studies have also shown that the microflora found at susceptible sites was similar in both caries active and caries free children. It is apparent that the local environment of the teeth will dictate the development of these lesions (Ripa, 1988).

Researchers are also examining if lactose intolerance is a risk factor for NC. In a recently published paper by Juambeltz et al. (1993) NC children were found to have higher lactose intolerance scores, based on symptoms, than did caries-free children. Their results were not
statistically significant but may warrant consideration. The prevalence of lactose intolerance varies amongst different ethnic groups and was found to be as high as 27 per cent among black children aged 1 to 2 years. This group is also affected by higher NC prevalence. In an area such as North York with such a highly diverse ethnic population the inclusion of lactose intolerance as a potential risk factor should be considered.

b) The Local Environment

The teeth of children who develop nursing caries have been exposed to considerable dietary challenge. *S. mutans* utilizes the carbohydrates found in cow's milk, breast milk or juice in their metabolism. Acids destructive to the teeth are formed which, over repeated exposure, will cause tooth decay. NC has long been associated with the prolonged use of a bottle containing sweetened juices, sweetened vitamin syrups, and the use of sugar sweetened pacifiers. The severity of the caries attack is a function of the liquid present in the mouth and the length of time the teeth have been exposed to the substrate. Because salivary flow is diminished at night, clearance and buffering of the offending liquid are reduced, and the caries process is exacerbated. Children with poor oral hygiene have been found to have greater caries experience (Winter et al., 1966; Goose and Gittus, 1968; Winter et al., 1971; Holt et al., 1982; Johnsen, 1982; Holt et al., 1988; Ripa, 1988; Davenport, 1990; Holm, 1990; Winter, 1990;).
c) Infant Feeding Practises and Dental Decay

i - The Role of Bottle Feeding

The role of the nursing bottle in the aetiology of NC has been well established over the last thirty years. In the Camden studies (1966-1988) more caries was found amongst those children who had been bottle fed (Winter et al. 1966; Holt et al., 1982; Holt et al., 1988). The prolonged use of a nursing bottle has been consistently shown in epidemiological studies to be a significant risk factor for the development of NC. One of the predominant factors determining whether a child develops NC is the manner in which the child falls to sleep. If the child drinks the contents of the bottle, then discards it and falls to sleep there is a much lower incidence of NC than for the child who falls asleep with the bottle unfinished still in his mouth (Juambeltz et al., 1993; Schwartz et al., 1993). This is understandable as this child will be exposing his/her teeth to the cariogenic liquid for a longer period of time than the child who drinks the liquid and then falls to sleep. It is this prolonged exposure, which will promote the demineralisation of the teeth in the pattern characteristic of NC (Newbrun, 1989; Ripa, 1988).

ii - The Role of the Pacifier

Some form of pacifier or dummy has been used to comfort children since the time of the Romans. The type of device used has changed over the years from a sugar bag, to a honey dipped 'dummy' to small hollow feeders filled with sweetened liquids. Comforter caries has
been recognized as a problem since 1861 (Winter et al, 1966). In 1966, Winter et al. studied 100 pre-school aged children with rampant decay and found the use of a sweetened soother to be a significant cause of decay. Goose and Gittus (1968) found similar results in their study of infant feeding methods, and dental caries. The three Camden studies covering the time span 1966-1988 have consistently shown the relationship between caries development and the use of a sweetened soother. In the Camden survey of 1987/88 sweetened soothers were used by 46 per cent of the children surveyed (Holt et al., 1988).

iii - The Role of Breast Feeding

In his article discussing the role of breast feeding in the development of NC, Roberts (1982) reviews a study conducted to determine the differences in nipple position and swallowing for breast-fed and bottle-fed babies. The mothers nipple was coated with barium sulphate powder in lanolin and studied the entire breast-feeding process by taking cineradiographs. The nipple came to rest at the junction of the soft and hard palate, and the sucking action deposited milk on the posterior soft palate, tongue and oropharynx stimulating the swallow reflex. A similar experiment was conducted with the artificial nipple and found that the infant often does not draw enough milk into the mouth to stimulate a swallow. The volume of milk that the baby receives is similar for breast and bottle fed infants, however the nipple and breast occupy a larger volume in the mouth than the artificial nipple. Therefore the milk accumulates around the teeth until enough volume is present to stimulate a swallow. It is felt by many that this evidence supports the theoretical mechanism for the occurrence of caries in bottle fed children,
and suggests that breast-feeding is not a likely cause. The major criticism of these papers is that the actual time that sucking was observed was only 4 seconds and therefore not sufficient to study either breast or bottle feeding, and that the position of the mothers breast was artificially postured to obtain clear cineradiographs (Roberts, 1982).

In one of the first epidemiological studies of decay in the young child, Pitts (1927) found no difference in the occurrence between bottle-fed and breast-fed infants regarding the occurrence of decay. Early case reports by Kotlow (1977) and Gardener (1977) were among the first to indicate a role for breast feeding in the aetiology of NC. These two articles highlighted six cases where NC occurred in children said to be only breast-fed. All cases were children who had been breast-fed on demand for prolonged periods of time.

Human and cow's milk both contain the sugar lactose. Experiments have been done to demonstrate the cariogenic potential of both (Rugg-Gunn et al.; 1985). Because cow's milk also contains high concentrations of calcium and phosphorus it may contribute to the mineralisation of the enamel. Cow's milk also contains the proteins casein and whey which can produce a protective organic coating on the enamel. Breast milk contains a higher concentration of lactose than does cow's milk (7.0 grams per cent versus 4.8 grams per cent) and does not possess the other potentially cariostatic properties. Human milk can depress plaque pH to a greater degree than cow's milk, but to a less degree than a 7 per cent sucrose solution. Because of this human breast milk is considered more cariogenic than cow's milk, and it seems likely that total breast feeding ad libitum can cause cavities (Rugg-Gunn, 1985).
The features of caries in children who have been exclusively breast-fed are reported to be:

1) A highly motivated and extremely well informed mother who states that there has been no use of other feeding methods;

2) A pattern of decay similar to NC;

3) Mother is practising true on demand breast feeding;

4) Teeth erupting in the mouth after cessation of on-demand feeding have not suffered a caries attack;

5) The baby is fed at least 7-8 times per day, and that the baby sleeps with the mother throughout the night, every night; and

6) That this pattern of feeding has continued beyond what is considered normal by modern society, ie. for a period of 1 1/2 - 2 years or more (Roberts, 1982).

However, in a recently published (1994) case-control study by Roberts et al, no relationship was found between feeding method or length of time the method was used, and NC in preschool aged children in South Africa (Roberts et al., 1994).
d) Social Factors

The first International Collaborative study by the World Health Organization reported that 'socio-psychological and cultural factors were much greater influences on dental health than the organization of the dental care delivery system' (Holloway, 1989).

The literature available on the measurement of health status and social inequalities is extensive... It consists of a multi-sectorial approach to health, drawing from medicine, psychology, sociology, economics, and analytic epidemiology. Very little of this literature deals with oral health however as dentistry has retained a narrowly clinical focus towards the understanding of oral health. This is a result of the historical ubiquitous nature of caries. Until recently efforts have been focused on treatment and prevention through the traditional mechanisms of water fluoridation, health education, and interventions at the individual level (Locker, 1989).

Although the relationship between health and socio-economic status has been recognized for a long time it was not until the publishing of the Black Report in Britain (1982) that theories as to the reasons for this relationship were discussed in a systematic manner. There are basically four categories of theoretical explanations of the relationship between health and the social factors discussed above (Locker, 1989).
i - Artifact Explanations

This theory purports that the inequalities in health between groups are not real, but rather the artifact of the measuring process trying to relate social class and health. This argument, usually held by statisticians, is based on the fact that changes in the traditional occupational structure of modern society, age differences among the socio-economic groups and changes in the classification systems used to define social class have confounded any attempts to measure health inequality trends over time or even at a point in time (Locker, 1989; Petersen, 1990).

ii - Natural and Social Selection Theory

This theory accepts that social inequalities in health do exist and are caused by a health selection process. Social class therefore is dependant on health. Health is seen as a prerequisite for economic success and determines a persons place in the class structure. People in poor health tend to drift down the occupational scale and become concentrated in the lower social classes, while people with good health move up the social scale. The class structure is therefore seen as a type of filter of the human species where one of the major forces of selection is health. This theory is supported by studies which have shown that chronic conditions such as schizophrenia lead to a downward occupational drift often ending in unemployment (Locker, 1989; Petersen, 1990). Evidence also exists that suggests a link between oral health status and social mobility. Dental conditions can greatly affect facial attractiveness and can therefore have a profound influence on an individuals chances in life.
with respect to educational, social and occupational success. According to this theory, the gap between health of the higher and lower classes would be there indefinitely and would in fact be inevitable regardless of what improvements were made in health for the whole population (Locker, 1989; Petersen, 1990).

iii - Materialist or Structuralist Explanations

This theory emphasizes the role that the external environment plays with respect to health. In this theory, socio-economic status is accorded a causal role and seen to be the major determinant of health. Health inequalities have their origin in material deprivation. Evidence in support of this theory has focused on differences in income, wealth, working conditions and the quality of housing and the domestic environment. The lower socio-economic groups tend to be disadvantaged in all of these. Inequalities occur because lower social groups are exposed to a more unhealthy environment. These people are engaged in more dangerous work, have poorer housing, and fewer material resources to secure the necessities for health such as an adequate diet. There are several studies that link increased levels of dental decay, edentulism and other oral disorders with lower socio-economic status (Locker, 1989; Petersen, 1990).
iv - Cultural, Behavioural Explanations

This theory stresses the way individuals in different groups choose to lead their lives. It focuses on the individual, and suggests that poor health in the lower social classes is due to voluntary lifestyle choices which are dangerous and health damaging. The problem with this explanation is that it has an overly simplistic view of behaviours such as smoking, alcohol use and diet. These behaviours are seen as individual choices which could possibly be modified with enough health education. There is abundant evidence with respect to socio-economic differences in knowledge, attitudes and health behaviours and their relationship to dentistry. People from the higher socio-economic groups are usually more knowledgeable about dental disorders and their causes. This is considered to be a function of higher educational levels and their interest in maintaining their health (Locker, 1989; Petersen, 1990).

v - Social Factors Related to Nursing Caries Development

Several studies have been undertaken to examine the nutritional, socio-economic and family characteristics of children with nursing caries in an attempt to predict those who would be at high risk. There is little doubt that dental decay in the pre-school aged child is related to the socio-economic level of the parents. In the industrialized world, higher levels of disease are seen in poorer, less educated, single parent, or recent immigrant families. In several large scale studies of NC in Great Britain the frequency of undesirable habits, and the incidence of
NC increased with decreasing social status (Davenport, 1990; Goose and Gittus, 1968; Winter et al., 1966; Holt et al., 1988; Holt et al., 1982; Winter et al., 1971; Winter, 1990; Johnsen, 1982; Holm, 1990). In these nations, nursing caries is seen as a disease of parental neglect or ignorance (Winter, 1990). In developing nations the trend appears to be reversed, with higher levels of disease seen in the more affluent families where adverse dietary habits are introduced faster than in the rest of the population. In these countries nursing caries is seen as a disease of parental over-indulgence (Eronet and Eden, 1992).

In the study by Eronet and Eden (1992) the nutritional, socio-economic and family characteristics of 71 Turkish children with NC and 224 age matched controls were examined. The parents were given a questionnaire and a three-day food diary to complete. In the group with NC the children were found to have an unbalanced diet with a high sugar content. The NC group was mostly from small families of middle to high socio-economic groups. Infant feeding patterns for the NC group showed that most of them were breast fed for less than 6 months or greater than 12 months, habitually had their meals sweetened in infancy, received a bottle at bed time and a few had the habit of sucking on a sweetened pacifier. The results were shown to be statistically different from the control group. An interesting finding in this study was that boys were twice as common in the NC group. In all other reports on the prevalence of NC boys and girls were equally represented. The authors explained this result by citing the tradition in Turkey of being over-indulgent with male children (Eronet and Eden, 1992).
2.2 Design Strategies in Epidemiology

Epidemiology can be defined as the study of the distribution and determinants of disease in human populations. Classically the determinant studied was a particular etiological agent either known to be, or thought to be associated with a given disease. Today the term determinant is used in a much broader sense. Determinants of disease may include biological factors, genetic factors, environmental factors and lifestyle attributes of the subjects under study. Epidemiological studies allow the researcher to quantify the relationship between a determinant and a disease outcome, and therefore suggest routes to alter the risk through intervention. The two groups of research strategies employed in epidemiology are referred to as Descriptive and Analytic studies (Hennekens and Buring, 1987).

Descriptive studies describe the general characteristics of a disease with respect to the epidemiological triad of person, place, and time (Hennekens et al., 1987). Demographic factors such as age, gender, ethnicity, marital status, occupation and lifestyle are considered when describing the distribution of a disease. The major advantage of this study design is the relative ease with which they can be conducted. In the descriptive study, the comparisons between exposure and disease status are implicit in the study design. These studies are relatively inexpensive to perform and may provide important information about a disease needed to formulate further research hypotheses (Hennekens et al., 1987).

Analytic studies differ from descriptive studies in that the comparison of exposures and disease
status is explicit in the study design (Hennekens et al., 1987). The investigator assembles
groups of individuals to systematically determine whether there are differences between
exposed and unexposed groups with respect to their disease status (Hennekens et al., 1987).
There are two categories of analytic studies, clinical trials and observational studies.

The unique feature of a clinical trial and all other forms of epidemiological investigations is
that the exposure status of the individual is allocated by the researcher. These studies provide
the most accurate data on the relationship between an exposure and the development of a
disease. One of the best dental examples of this methodology is the Vipholm Study from the
1940's (Newbrun, 1989).

The second type of analytic study is the observational study. In this type of study the
investigator observes the natural course of the exposure and disease process. There are two
types of observational studies which are referred to as cohort and case-control studies.

2.2.1 The Case Control Design

For the purposes of this investigation the Case-Control design was selected. These studies
have also been referred to as retrospective studies, because the paradigm followed proceeds
from effect to cause (Schlesselman, 1982). This type of study is the most efficient means of
studying etiological factors related to diseases with a prevalence of less than 10 per cent, and
those disease with a long latency period. This method allows the investigators to
simultaneously evaluate a wide range of potential risk factors, markers and determinants for nursing caries (Hennekens and Buring, 1987). The case-control methodology compares a group of people affected with a disease to a group of people not affected. Cases and controls are therefore chosen based on the presence or absence of the disease under investigation respectively. These two groups can then be compared with respect to current or past attributes or exposures proposed to be associated with the development of the disease. The studies purpose is to discover those factors that are different between the affected and non-affected groups which could explain the patterns of disease occurrence (Schlesselman, 1982).

Case-control studies may be population-based, where all cases of the study disease occurring within a defined geographical area, during a specified period of time are identified, and included in the study. Controls are selected from the general population of that area. These studies may also be institution based. In this situation all of the cases being treated in a specific institution are enrolled in the study, with controls chosen from patients of that institution not being treated for the study disease.

The technique of looking retrospectively is commonly used by dentists and physicians when taking a history as an aid in making a diagnosis. The use of the case-control methodology in modern epidemiology began in the 1920's when this technique was used by a few investigators to study cancer. It increased in popularity after the Second World War, and is now commonly used in medicine, for the study of rare and chronic illnesses (Schlesselman, 1982). This technique has not been used commonly in the study of dental disease, however it has been
increasingly utilized over the last ten years. An example of a recent case-control study, in
dentistry is that by Roberts et al. in 1994.

The scientific basis for the analysis of this method was clearly demonstrated in the 1950's by
Cornfield (1954) and Mantel and Haenszel (1959). Mantel and Haenszel demonstrated a
method to accurately estimate the relative risk from stratified data and use the chi-square test
for association (Schlesselman, 1982).

a) Strengths of the Case-Control Methodology

As a research methodology case-control studies offer several advantages for examining the
relationship between an exposure and a disease. These include:

1) Relatively quick and inexpensive compared with other analytic
   studies;

2) Well suited to the evaluation of diseases with long latency
   periods;

3) Optimal for the evaluation of rare diseases. This has been defined
   as those where the prevalence is less than 10 per cent; and

4) Can examine multiple etiological factors for a single disease, and
are therefore a useful first step in the identification of risk factors for a disease (Schlesselman, 1982).

b) Limitations of the Case - Control Methodology

The paradigm followed in a case-control study results in several limitations;

1) It is inefficient for the evaluation of rare exposures, unless the attributable risk per cent is high;

2) Cannot directly compute incidence rates of disease in exposed and non-exposed individuals, unless study is population based;

3) In some situations, the temporal relationship between exposure and disease may be difficult to establish; and

4) Is particularly prone to bias compared with other analytic designs, in particular selection and recall bias (Schlesselman, 1982).
3. Need for the Current Study

3.1 Study Environment

North York is the second largest of the six municipalities of Metropolitan Toronto, with a population of 562,564 in 1991. North York accounted for 24.7 per cent of the population of Metropolitan Toronto. As a result of immigration patterns, the city is composed of people from over 100 different ethnic groups, who speak over 65 different languages. Over one third of the population identify a language other than English or French as their mother tongue.

The dental health of the community of North York has improved since the introduction of communal water fluoridation in 1963. In Ontario, dental health surveys of children have taken place every four years, so that the dental health of North York children can be compared and contrasted with that of the province as a whole. One measure of dental disease used in assessing oral health is the retrospective index referred to as the DMF (decayed, missing and filled) Index. This index measures the results of past disease experience. For children this index is reported as the d (decayed primary teeth) e (extracted primary teeth) f (filled primary teeth). Based on the results from the provincial screening in 1990, North York had higher def scores than the rest of the Province. In 1990 the def for three year olds in the province was reported as 1.31, being higher than for five year olds (1.16). Data on caries prevalence for the pre-school age group are not reported on a consistent basis by all health units and are therefore likely unreliable (North York Public Health Department, 1995).
3.2 Pilot Project

In the academic year 1993/94, the North York Public Health Department conducted a cross-sectional survey of 24 randomly selected day-care centres in the city of North York. This was done as a summer practicum project in conjunction with the Department of Public Health for the City of North York. The results of this pilot study, although not statistically significant, did suggest that certain risk factors may be important to the development of NC in this population (See Table 2). The investigators (Dr. P. Abbey and Dr. A. Jokovic) found a prevalence of NC of 5.9 per cent, which is almost double that of the prevalence figure determined in the only major Canadian paper published on NC in an urban population (Derkson and Ponti, 1982). If these results were valid, nursing caries would be three times as prevalent as measles, mumps, pertussis and chicken pox, alone or combined (See Figure 4). Because of these results further study into the risk factors, markers and determinants was warranted so that appropriate public health promotion programmes could be developed.

3.3 Study Rationale

Based on a review of the literature, the apparent burden of illness to the public and the results of the pilot study, we decided that risk factors associated with this condition required further elucidation. The main reasons for under-taking this study were:

1) There was no estimate of the burden of illness in the pre-school
population in North York, caused by nursing caries. These cases represented the most costly treatment provided through the C.I.N.O.T. Programme.

2) Due to immigration patterns there has been an increase of immigrants to the area. From the literature and our pilot study, NC may be more prevalent in new immigrant families. Because North York is a city of people from diverse backgrounds we had an opportunity to examine the influence of birthplace of the child and parents on the development of nursing caries.

3) There is a large child population in North York, with approximately 28,000 children between the ages of 1 and 4 years of age in the city. Therefore if the prevalence of NC is between 3 and 5 per cent, there would be between 780 and 1,300 cases in this population.

4) The risk factors, markers and determinants for nursing caries have not been well defined and therefore community programmes may not currently be appropriately focused. There has been debate as to whether programmes should be total population based or targeted to specific high risk sub-groups of the community. This study may help to determine whether oral health promotion and disease prevention strategies for NC
should be targeted to only those at high-risk or be population-based.

5) The results of the pilot study were reported by the North York Public Health Department, Dental Division in local and national newspapers. These reports generated letters of response by the public indicating a public interest in the topic.

3.4 Study Design

This study, conducted in the academic year 1994 / 1995, was an observational, analytic epidemiological investigation using the case-control design. This method was chosen as it allowed the investigators to simultaneously evaluate a wide range of potential risk factors, markers and determinants for nursing caries (Hennekens and Buring, 1987). The investigation was population-based in that all cases of the study disease occurring within a defined geographical area, during a specified period of time were identified, and the entire case series included in the study. Information regarding exposure status and disease status were elicited at different points in the investigation. Case status was determined at the initial screening, with exposure status elicited through the response to the questionnaire. The questionnaire also confirmed the case status for treated cases. As discussed earlier this is appropriate were there is concern that recall of information in the past may not be reliable. The questionnaire asked questions regarding both past experiences and current experiences in an effort to obtain accurate information. Because the condition under study involved young children, the
exposures of interest did not occur in the distant past. We felt confident that the parent completing the questionnaire would have a good recall of the exposure history of the study child.

As part of the objectives of this study, we set out to investigate the risk factors, markers and determinants for nursing caries. While there is inconsistency in the literature regarding the definitions of these terms, in this study we will use the definitions that follow.

**Risk Factor** - an attribute or exposure that increases the probability of occurrence of disease, and which can be modified. A high level of sugar intake would be an example of a modifiable risk factor for the development of dental caries;

**Marker** - an attribute or exposure associated with the increased probability of occurrence of disease, and which can be used as an indicator of disease. This attribute or exposure is not necessarily causal for the disease. In the study of NC maternal education may be considered a marker. Children of poorly educated mothers may appear to be at an increased risk for NC, however do not get the disease;

**Determinant** - an attribute or exposure that increases the probability of occurrence of disease, and which cannot be modified. An example of a determinant for NC would be the age of the child, as only young pre-school aged children are at risk for this pattern of decay (Johnson, 1991).
3.5 Methods of Obtaining Health Behaviour Information

There are primarily three methods of obtaining health behaviour information; face-to-face interviews, telephone interviews and mailed out, self-completed questionnaires. The method utilized affects the cost of the project, the response rate and the way respondents answer the questions (Norman and Streiner, 1989).

The direct mail-out of questionnaires was chosen for this project. This method was determined to be the most efficient for a graduate student to administer, and was manageable within the confines of the academic setting. Dillman (1978) has determined that response rates of 75 per cent in a heterogeneous population and 90 per cent in a targeted group are possible using the direct mail-out technique. The advantages of this technique are:

i - it is the least expensive method. In a study by Siemiatycki (1979) it was determined that the average cost for a mail-out was $6.08 per household, $7.10 for a telephone interview, and $16.10 for a face-to-face interview. The main reason for the decreased cost is that as with phone interviews all of the work can be co-ordinated from one office location.

ii - as there is no interviewer present, either in person, or on the phone social desirability bias tends to be minimized (Streiner and Norman, 1989).
The disadvantages of this technique are:

i - if a subject does not return the questionnaire it is very difficult to get any demographic information about them;

ii - subjects are more likely to refuse to answer questions, or answer in such a way as to make the question unusable.

iii - subjects may not answer the questions in the order intended;

iv - multiple mailings are necessary, and therefore it is necessary to maintain a ledger to keep track of the disposition of the respondents; and;

v - there may be a delay of up to three months until all of the questionnaires have been received (Streiner and Norman, 1989);

3.6 Study Objectives:

The primary objectives of this project are:

1) To provide an estimate of the prevalence of nursing caries in the 4-year-old
2) To identify the risk factors, markers and determinants for nursing caries in the four-year-old population in the city of North York.

From the results obtained from the two primary objectives we anticipate completing the following subsidiary objectives:

1) To determine the relative risk, attributable risk and population attributable risks associated with the identified risk factors.

2) To examine parental awareness of the risks associated with certain bottle and breast feeding practices.

3) To examine patterns of dental service use, and preventive dental behaviours amongst these families and their influence on the development of NC in the young child;

4) To determine if any oral health care information is being disseminated to parents regarding NC.
5) To determine the sources of child oral health care information for these families;

We intend to establish a data-derived hypothesis regarding the risk factors, markers and
determinants for NC in the North York population, and therefore aid dental public health
managers develop appropriate health promotion and disease prevention strategies for those
families at the greatest risk for the development of nursing caries. Our working hypothesis
was that the development of nursing caries in the child population of North York was
associated with the following risks: aberrant feeding habits, low maternal education, low
family income, and low parental knowledge. These factors were chosen as they were
previously cited in the literature, as well as being found to be potentially significant in the pilot
project for this study. The case-control methodology was chosen as it represented the most
efficient means of determining if there was a statistically significant difference with respect to
these risks, between those families with children with NC and those without.
4. Methods

4.1 Study Population

For this study all of the children enrolled in junior kindergarten in North York schools were eligible for screening. This group was chosen as they represent the end point for nursing caries activity in the young child and they were readily accessible. Approximately 90 per cent of the children in North York of this age register for Junior Kindergarten. Therefore, there were approximately 6,500 children available for screening.

4.2 Case Definition

Cases were defined by the presence of active, arrested or restored labial or palatal caries on two or more primary maxillary anterior teeth. Children with evidence of extraction of these teeth were also included as cases if it could be determined (by the parental response to the questionnaire) that the extractions were for nursing caries. Cases with evidence of treatment, for nursing caries, were defined as 'Active' if they also had one or more unrestored carious maxillary anterior teeth. Cases were defined as 'Treated' if they had one or more restored or extracted maxillary anterior teeth, with no active caries present.

Parents were asked on the questionnaire if the child had received dental extractions of primary maxillary anterior teeth because of cavities. Parents were also asked if they thought their
child had decayed teeth and when they first noticed this. This was done to determine a time frame for the development of decay in the child. Cases were classified as early onset or late onset nursing caries based on the number of teeth affected and the age first noticed by the parents.

Controls were any child who did not have nursing caries, and was therefore a non-case. These children may have been caries free, or may have had decay present in teeth other than the primary maxillary anteriors.

4.3 Identification of Potential Cases and Controls

The Community Dental Services Division of the City of North York Public Health Department screens all children enrolled in Junior Kindergarten annually. The children are examined visually and with a mirror and explorer by a dental hygienist. No radiographs are used. The hygienist uses the nominal roll form to record results. Specifically for the purposes of this study, the dental hygienists performing the screening received instructions from the investigator to ensure that all of the screening teams were using the same criterion for the identification of a potential case. The results of this screening process identified potential cases and controls.

Potential cases were those children who had caries or evidence of treatment as described above. The potential controls were the two non-case children immediately preceding the case
on the nominal roll. Two controls per case were selected. It was hoped that a one-to-one case-control ratio could be achieved. The investigator randomly selected 10 per cent of the potential cases and controls to monitor the validity and reliability of the screening reports regarding the identification of potential subjects for the purposes of this study. The total number of potential cases identified was used as the numerator for the estimate of NC prevalence in North York.

4.4 Inclusion Criteria

All cases and controls had to be 4 years of age or under at the time of screening. All cases and controls had to have their primary anterior dentition in place or evidence of treatment that was verifiable. To improve the methods from the pilot study we added treated cases to the study group in order to increase the number of children eligible for the study. For many general medical conditions, the identification of all treated cases is a problem, as most diseases can be treated without leaving any trace of the disease. In these situations potential cases remain unidentified. In the study of nursing caries, a case is easily identifiable as soon as the caries process has begun and remains so even after treatment has occurred. This is because all forms of dental caries treatment, including restoration or extraction, leaves a permanent record, until the succedaneous teeth erupt.
4.5 Exclusion Criteria

Children were excluded from the study if they were 5 years of age or older, or if they had permanent anterior teeth present.

4.6 Enrolment of Cases and Controls

The parents or guardians of all identified cases and controls were sent the same letter and questionnaire requesting their participation in the study. Their consent to participate, evidenced by the completion and return of the questionnaire, made that child an actual subject in the case-control aspect of the study.

4.7 Ethical Considerations

Participation in this study was entirely voluntary for the parents. Their decision to participate in no way affected their receipt of services from the Dental Division of the City of North York. There was no risk to the child or their family by participating in this survey. Participants were free to choose not to answer some of the questions. All information was kept strictly confidential. The child's name and address did not appear on any of the forms returned by the family to the researchers. The master list of study subjects remained in the possession of the researcher in a locked facility at the Faculty of Dentistry. Only group statistics were reported on. All aspects of the survey design and protocol received scientific approval by the
Faculty of Dentistry and ethical approval from the University of Toronto Human Subjects Review Committee, the North York Public Health Department, the North York Board of Education, and the Separate School Board.

4.8 Sample Size Calculation

The sample size estimate for this project was determined using the sample size calculation function of the Epi Info computer programme. The sample size estimated to be required was 222 children. This would be a 1:1 case-control sample, with 111 cases and 111 controls. Using a prevalence estimate of 4 per cent, a total of 5,550 children would need to be screened.

The parameters used in the calculation of the sample size were:

2) The relative risk estimate, the odds ratio (OR = 3.64), used in this calculation, was based on the results of the pilot project. The OR used was for the modifiable risk factor with an OR greater than 2 (use of a bottle in the crib) found in the pilot study. In this way it was felt that the sample would be large enough to examine at the most commonly associated factors.

3) Type 1 error (alpha) refers to the probability of rejecting the null hypothesis when it is true. To be considered statistically significant the magnitude of the alpha should be less than or equal to .05 per cent. The type 1 error is equal
to the p value (Hennekens and Buring, 1987). For this study p = .05 will be considered significant.

4) Type 2 error (beta) refers to the probability of not rejecting the null hypothesis when in fact it is not true. This should not be more than 20 per cent or .2 (Hennekens and Buring, 1987).

5) The power of a study is the probability of rejecting the null hypothesis and concluding there is a statistically significant difference between the groups when one truly exists. This is equal to 1 - beta. In this study beta will be set at .2 therefore the power of the study will be .80. This means that we have an 80 per cent chance of showing statistical significance when there is truly a difference between the groups (Hennekens and Buring, 1987).

6) The risk of exposure in the 'not ill' group was set at 80 per cent, based on the pilot study results.

It was anticipated that the sample size should be larger than that estimated. A larger sample size would display less variability within the population and therefore the conclusions drawn would be more reliable. Because of this we used all of the children screened as our sample, and analyzed data from all of the cases and controls who participated.
Screening by the hygienist teams commenced on September 8, 1994. As potential cases were identified corresponding controls were selected. This process of recruitment continued until all of the Junior Kindergarten classes in North York had been screened.

The child's address and phone number were available from the nominal roll. In cases where the address and phone number were not available we obtained that information from the North York Public Health Department records. The direct mail-out technique was chosen as it was the most amenable to use by a graduate student. Parents of potential cases and controls were sent a copy of the questionnaire and a covering letter explaining the study and requesting their participation (See Appendix 1A). Also included was a form used by the North York Public Health Department, written in ten languages, advising the recipient that the information they are receiving is important, and suggests that they get someone to translate for them (See Appendix 1B).

If the parents did not wish to participate they were asked to return the final page of the questionnaire in the stamped envelop. This acknowledged their receipt of the information and their decision not to participate. The letters and questionnaires were re-mailed two times in the event of non-response to the initial mailing.

The original research proposal stipulated that the language status of families who had not
responded after three mailings would be determined from school records. If there was a known language barrier, the family was to be telephoned by a translator and asked to participate. If they agreed, a shorter version of the questionnaire would be administered at that time (See Appendix 1C, questions circled are those to be asked in the shorter format). The shorter format was to be used as it was easier to translate and may have facilitated persistent non-respondents to participate. This strategy was not pursued as the number of families with reported language barriers was minimal, and the cost of pursuing this strategy prohibitive.

Non-responding families with no known language barriers were also contacted one time by telephone and asked to participate with the shorter format.

The questionnaire solicited responses regarding risks identified from the current literature. It consisted of 64 items which were reviewed, and tested in the pilot study. Subsequent to the pilot project, the questionnaire was revised to eliminate, or clarify questions which were confusing to the respondents and therefore poorly answered. Some questions were added to reflect an attempt to establish additional markers and determinants for nursing caries.

The six components of the questionnaire can be seen in Appendix1A, 1B, and 1C. They are:

1) A covering letter to the parents, including a note in several languages regarding the nature of the correspondence;

2) A review of the child’s dental history (Q 2 - Q 22);
3) A review of the child's medical history, including the mother's pregnancy and delivery (Q 23 - Q 27);

4) The child's feeding history (Q 28 - Q 44);

5) Sources of child health information (Q 45 - Q 53);

6) Demographic information pertaining to the family (Q 54 - Q 64).

4.10 Time Line

Data collection began in September, 1994 and continued throughout the school year until May 1995. During this time period, names of cases and controls were collected and mail-outs of questionnaires and letters proceeded. As data were collected the information was entered onto a personal computer. In June 1995 data analysis was begun, and data transformation and analysis completed. The results of the study were presented at the University of Toronto Faculty of Dentistry in January 1996, at a Post-Graduate student seminar.
4.11 The Variables Under Study

4.11.1 The Dependant Variables

As discussed in Section 4.2, the cases were divided into two groups, active cases and treated cases. Data were analyzed separately for each of the case groups, as well as the total group of cases, versus the controls. By analyzing the data in this fashion we were able to examine differences between the cases and controls, as well as differences between the types of cases based on their treatment status.

4.11.2 The Independent Variables and Manipulation of the Data

From the 64 questions on the questionnaire there were 87 variables for study. In addition to these, 60 new variables were created from existing questions to summarize the information obtained, or to group it for analysis. This was done by recoding data and using the 'Count Command' in SPSS. The 'Count Command' creates a numeric variable which records for each case the number of times some value or list of values occurs for that variable (Norusis, 1988).

Of the total number of variables only 8 were found to be statistically significantly related to the development of nursing caries in this study population. After the initial uni-variate analysis and cross-tabulation, all of the variables were dichotomized to facilitate analysis using logistic regression. The regression analysis was run three times with active cases, treated cases and total cases analyzed with the eight statistically significant variables.
The eight variables used in the final analysis were:

1. Variable related to dental knowledge - a count variable was created that represents a cumulative knowledge score. The question used to create this variable was N44. This question was made up of 7 component statements to determine the respondent’s knowledge of things that may be harmful to a child’s teeth. The variable counted the number of times the respondent responded correctly to a statement. The score therefore ranged from 0 to 7.

2. The responses to the questions on brushing appeared to be poorly answered. A summary variable using the count command was created that represents a cumulative score of brushing frequencies. The questions used to create this variable were N7 a,b,c. These questions inquired when the child’s teeth were brushed. The choices given were: morning time - never (1), sometimes (2), always (3); after meals - never (1), sometimes(2), always (3); bedtime - never (1), sometimes (2), always (3). The intermediate variable counted the scores and therefore ranged from one to nine. The final variable was dichotomized at one or less times per day and two or more times per day.

3. Variables related to the respondent’s place of birth - for all children in this study 70% of mothers were born outside of Canada. Over 40 different countries were listed as maternal birthplace. There were too few respondents in each country to make analysis meaningful. The responses were then grouped according to the World Development Organizations criteria as developed, developing and least developed countries. Finally the respondents
were dichotomized into mothers born inside or outside of Canada. This same approach was used for paternal and child's place of birth.

4. Variable related to family income - question N64 asked the respondent what their approximate total household income was for the year 1993, before tax deductions. The categories offered were: less than $19,000; $20,000 to $39,000; $40,000 to $59,000; greater than $60,000; don't know; don't wish to respond. The data were initially analyzed using these six categories. To facilitate the analysis using logistic regression, and for comparison with other data from North York, the data were then collapsed into two categories, below and above $40,000.

5. Variable related to payment of dental costs: question N19 asked the respondent how their family dental costs are paid. The possible responses were - insurance from work; government assistance; paid by the patient with no insurance; other means. All of the respondents who chose 'other' responded that their child received their dental care through the school.

6. Variable related to the family's pattern of dental visiting - question 20 asked the respondent who in their family went to the dentist in the past year. The options were: no one; the child's mother; the child's father; this child; another child in the family; or another person. The variable was analyzed using this array of values.
7. Variable related to the child’s dental services utilization - question N15 asked the reason for the child’s first dental visit. The choices given were: regular check-up; pain from a tooth; concern about the appearance of the teeth; other. In the other response space people were given the opportunity to specify the reason. The most frequent reason given was extraction or filling of a tooth. These responses were recoded into a binary variable to compare children who went for a regular check-up with those who went for treatment of a specific problem.

8. Variable related to the source of health care information for the family - question N51 asked the respondent who their primary source of child care information was. The choices given were: family members; friends; the child’s medical doctor; public health nurses; the child’s day-care centre or school; all other sources. All of the respondents choosing 'other' specified that this consisted of their own reading and research. The responses were then converted to binary form with family, friends and other constituting personal sources, and medical doctor, public health nurses and day-care provider constituting professional sources. This was done to facilitate the analysis of this variable in a logistic regression equation, and the comparison of the results with another study done in North York.

Two other groups of variables were analyzed:

1. A variable was created to combine risk factors - the anticipated risk factors were also combined to determine if there were a threshold effect of the behaviours. A count variable
was created using the SPSS program to summarize the number of risk factors (low dental knowledge, infrequent brushing, and use of a bottle in bed), that respondents reported having. The values for this variable were either: none, one, two or all three risk factors. The number of risk factors reported were compared between active, treated, and all cases versus the control group.

2. The risk behaviours which were expected to be important were grouped into a single variable using the count command of SPSS. This variable represented the number of times the respondent affirmatively responded that they: gave the child a bottle in bed, snacked frequently, snacked on cariogenic foods, used a sweetened soother, weaned the child from the breast after one year of age, and weaned the child from a bottle after the age of 24 months.

4.12 Sources and Control of Bias

Bias can be defined as the deviation of the experimental estimate from the true value. There are three categories of bias (Hennekens et al., 1987; Schlesselman, 1987; Choi and Noseworthy, 1992).
4.12.1 Selection Bias

Selection bias occurs during the design phase of the study and can not be subsequently controlled for during analysis. This type of bias results from the way in which the sample groups were chosen. In case-control studies selection bias occurs when the cases and controls are chosen based on different criteria (Choi and Noseworthy, 1992). Bias can occur in either direction, thereby increasing or decreasing the estimated magnitude of the relationship between the exposure and the disease. There are several different types of selection bias.

a) Berkson's Bias

This type of bias, also known as hospital bias, refers to bias incorporated into the study by choosing participants from only one type of institution. In this study Berkson’s bias should not be a problem as both cases and controls were chosen from several different schools, from both public and separate school boards, as well as from privately funded institutions.

b) Neyman's Bias

This form of bias is also referred to as Prevalence/ Incidence Bias. This type of bias occurs when there is a time lag between the diagnosis of the disease and recruitment for the study. When this occurs it is possible that some cases will be lost due to death. Fortunately caries is seldom life threatening and therefore subjects should not be lost due to mortality. It is
conceivable however that due to a time lag between screening and recruitment that some cases or controls may have moved or change schools and therefore be lost to the study.

c) Membership Bias

This type of bias, also referred to as the "Healthy Worker Effect", may have been a source of bias in this study. Children who were not enrolled in the schools screened, because of medical reasons would not have been included in the sample population. This would have had the effect of biasing the results toward unity as medically compromised children may have been at increased risk for nursing caries.

d) Non-Response Bias

This type of bias affects all types of studies. There may have been differential participation of either cases or controls on the basis of their exposure and disease status. In this study it was seen to be more of a problem with the control group. It is hypothesised that this was because the parents of these dentally healthy children had a lack of interest or motivation to participate as they saw no relevance to their child.
4.12.2 Information Bias

This second category of bias occurs due to systematic error in the measurement of disease and exposure status.

a) Recall Bias

This is a problem which affects the case control design as we are asking people to recall events from the past. There may have been differential reporting or recording of exposure information between study groups because of their disease status. People may have forgotten, or their recall may have been altered by advice they have received subsequently. One of the potential risk factors under examination in this study is the use of bottles by infants and toddlers. It is known from the literature that prolonged non-nutritive bottle feeding can promote nursing caries (Fass, 1962; Davenport, 1990; Goose and Gittus, 1968; Johnsen, 1982; Newbrun, 1989; Schwartz et al., 1993; Winter, 1990). Parents who know that their child has this problem, and who have been informed that the cause was most likely their use of a bottle may not accurately report their child's history of feeding practices. This will have been more of an issue for cases who had received dental treatment for NC prior to participating in the study. To identify the effects of this bias, treated and untreated cases were compared with each other and with the controls.
b) Social Desirability Bias

Social psychologists refer to a particular type of response pattern as 'Social Desirability Bias', which is closely related to recall bias. This occurs when people asked sensitive questions, consciously or unconsciously, bias their response toward the socially acceptable answer. The subject is not necessarily aware of this and may not be deliberately trying to deceive the researcher. In effect the respondents are 'putting their best foot forward'. When an individual is aware of their deception and is consciously trying to create a false positive impression it is called 'faking good'. This type of bias has been studied since the 1950's and has been shown to depend on the individual, gender, cultural background, the topic of the question, and the method of administering the question (face to face versus self completed questionnaire). If the object of the questionnaire is to collect factual information such as whether a child was put to bed with a bottle, the results obtained may underestimate the true prevalence of that undesirable behaviour, especially among cases. The occurrence of positive or socially desirable behaviours may therefore be overestimated (Streiner and Norman, 1989). In a study by Visser, et al. (1994) it was determined that the social desirability tendency accounted for 12.1 per cent of the variance in all of the social scientific measures of their study of dental health in 15 year-old children. The areas in which the social desirability was most prominent were questions relating to attitudes toward health behaviours. Measures that were not influenced by social desirability included dental hygiene, knowledge about dental health, sources of information. They found that the social desirability tendency was higher when the respondents had a lower education and if the parents had a lower class of occupation (Visser et
c) Inter-Examiner Bias

The people used for the screening and identification of cases were well trained and calibrated for the diagnosis of caries in the young child. While the researcher re-examined 10 per cent of the cases and controls to ensure inter-examiner reliability, we did not recheck the entire population to determine if the screening teams systematically over or under-reported cases.

d) Questionnaire Design and Method of Administration

The design of the survey instrument and its design can also bias the results. The survey instrument used has been extensively reviewed, revised and tested. The questionnaire was mailed out using a three stage approach recommended by Dillman (1978). This was done in an effort to maximize the response rate.

4.12.3 Confounding

There are three explanations for the erroneous presence of a statistically significant association between an exposure and an outcome. These are: chance, bias, and confounding. Confounding occurs during the analysis stage of a study when controlling techniques such as stratification are not employed (Choi and Noseworthy, 1992).
Confounding is part of the complex interrelationship between exposures and the development of the outcome under study. It has been described as a mixing of effects (Rothman, 1986; Hennekens and Buring, 1987; Choi and Noseworthy, 1992). The estimate of the magnitude of the effect of an exposure on an outcome is distorted by the effect of a third extraneous factor. This distortion can be significant and cause an over-estimation or under-estimation of the effect, and can even change the observed direction of the relationship. The concept of confounding is central in epidemiology today, and is especially important with respect to non-experimental studies (Rothman, 1986).

There are three parameters for determining whether a factor is a confounder:

1) For a variable to confound a relationship it must be associated with both the exposure and the disease under study. The variable does not need to be causal for the disease.

2) The potential confounder must be predictive of the outcome independent of its association with the exposure under study.

3) The potential confounder cannot be an intermediate in the causal chain between the exposure and outcome under study.
During the design phase of any study it is important to consider what variables may represent confounders and to ensure that adequate information is collected. It is important to not only identify the presence or absence of a confounder, but to quantify the magnitude and likely direction of its' effect (Hennekens and Buring, 1987).

The effect of confounding can be controlled for either during the design or analysis phase of a study depending on the nature of the investigation. There are three ways to control for confounding during the design of an analytic study:

1) **Randomization:** the procedure of choice in intervention studies. Subjects are allocated randomly into treatment or non-treatment groups on a random basis. If there is a sufficient sample size randomization will ensure that all potential confounders are evenly distributed throughout the sample.

2) **Restriction:** admissibility to the study group is restricted to individuals who fall within a specified category of the confounder.

3) **Matching:** study subjects are chosen such that potential confounders are distributed in an identical manner among the study groups. The main disadvantage of matching is that the factor used to match subjects can then no longer be considered as a risk factor under study (Hennekens and
There are two methods of controlling for confounding utilized during the analysis phase of a study:

1) **Stratified Analysis:** this technique involves the evaluation of the association within homogeneous categories (strata) of the confounding variable. This technique is easy to conduct, it allows for the examination of effect modification, and is easily understood by the reader. The main disadvantage of stratification is the inability of this technique to control for more that a few potential confounders.

2) **Multi-Variate Analysis:** this technique allows the researcher to control for a number of confounding variables simultaneously. This type of analysis involves the construction of a mathematical model to describe the association between an exposure, potential confounders and the outcome in question (Hennekens and Buring, 1987). This is the method used in the analysis of this study.
4.13 Data Analysis

All data were analyzed using the SPSS PC+ (Norusis, 1988) and EPI Info (Dean and Dean, 1994) computer programmes. The analysis of a case-control study involves the comparison between the two groups with respect to the frequency of exposure to a potential risk factor. We utilized a stepwise application of analytic methods, namely simple descriptive statistics, cross-tabulations, estimates of relative risk and multivariate analysis using logistic regression (Johnson, 1991; Hennekens et al., 1987).

As discussed in Section 3.6, one of the objectives of this study was to identify the risk factors, markers and determinants of NC development in the pre-school population of North York. The terms risk factors, markers and determinants are used to define exposures when planning public health and health promotion programs. By knowing what exposures increase the risk of disease development, planners can target programs to the specific populations at the greatest risk. When analyzing data we redefine these terms as variables.

There are three types of variables to be considered, dependant, independent and confounding. The primary dependant variable was the development of NC. The dependant variable is that variable which is dependant on some exposure for its development. Independent variables are those events, or exposures which act to increase the risk of developing the outcome under study, the dependant variable. The independent variables in this study were those exposures we were examining with respect to their effect on NC development, such as feeding patterns,
knowledge, income, and ethnicity. An example of an independent variable in this study was the use of a sweetened soother.

Confounding variables are the third type of variable under consideration. Confounders distort the estimate of the magnitude of the effect of an independent variable on the dependant variable. This distortion can be significant and cause an over-estimation or under-estimation of the effect and can even change the observed direction of the relationship (Rothman, 1986).

From the pilot project results, and the available literature, the main independent variables under consideration were: maternal education, parental country of origin, infant feeding practices (bottle or breast at bed-time), type of liquid in the bottle, preventive dental practices and attendance at pre-natal classes. Minor variables considered are the child's birth weight and possible lactose intolerance status. Socio-economic status is potentially a confounder in the analysis of this study. Because of this, it was controlled for, through multivariate analysis, when considering the effect of a given variable on the development of NC (the dependant variable).

As noted in Section 4.4, we chose to include both Treated and Active cases in this study. We analyzed the results comparing the control Group with the total Case group as well as the Active and Treated Cases separately. This was done to explore if there were any important and / or statistically significant differences between the types of cases.
The outcomes in the analysis of an exposures relationship to the disease is best described using a 2 x 2 contingency table. From these data it is then possible to formulate statistics which quantify this relationship.

**Example of Table**

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Controls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to Variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>a</td>
<td>b</td>
<td>n</td>
</tr>
<tr>
<td>No</td>
<td>c</td>
<td>d</td>
<td>m</td>
</tr>
<tr>
<td>Total</td>
<td>r</td>
<td>s</td>
<td>t</td>
</tr>
</tbody>
</table>

Participants in a case-control study are selected on the basis of their disease status, and often the incidence of disease in the general population is not known. It is therefore not possible to calculate the relative risk associated with exposure factors. In a case-control study, the controls provide an estimate of the frequency of exposure expected among individuals free of the disease. It is therefore possible to quantify the risk associated with each factor, either individually or in combination. The odds ratio (OR) is therefore used as an estimate of the relative risk, especially when the prevalence is less than ten per cent. The OR is the ratio of
the odds of exposure among the cases to that among the controls. Using the simple two-by-two contingency table the OR can be expressed by the formula:

\[ \text{OR} = \frac{ad}{bc} \]

The importance of the odds ratio increases proportional to its numerical value. An odds ratio equal to 1 indicates that the variable has no influence on the development of the condition under study. An odds ratio between 1.2 and 1.5 indicates that the factor is important with respect to the development of the disease. An odds ratio of 1.5 to 2.5 indicates a mild relationship, 3.0 to 5.0 is moderate, 5.0 to 7.0 is a strong relationship and greater than 7.0 is very strong (Rothman, 1986).

The test of significance used was the 95 per cent confidence interval, which represents the boundaries within which 95 per cent of the responses could be expected to be found. If the interval does not include the number one then it is considered significant. A narrow confidence interval is better. A wider interval reflects increased variability in the sample, or the effects of a small sample size.

\[ 95\% \text{ C.I.} = (ad/bc) \exp \left[ \pm z \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}} \right] \]
The second test of statistical significance that was used is the Pearson's chi-square test for association. The formula for this is:

\[ \chi^2 = (|ad-bc| - 1/2t)^2 \times \frac{nmrs}{nmrs} \]

The p-value obtained from this test reflects the role of chance in the results obtained. Results are considered statistically significant if \( p \) is less than or equal to 0.05. This means that the chance of getting this result by chance is less than 0.05 per cent.

The attributable risk (AR) measures the excess risk of disease in individuals exposed compared to those non-exposed. The AR is defined as the difference in the incidence rates in the exposed and non-exposed groups. In case-control studies it is often not possible to calculate the AR as incidence rates of disease in the two groups is not available. In this situation the AR per cent is calculated using the estimated relative risk (Hennekens et al., 1987).

\[ \text{AR}\% = \frac{(RR - 1) \times 100}{RR} \]

The AR has also been referred to as the etiological fraction, attributable fraction, excess fraction and the population attributable risk per cent (Coughlin, et al., 1994). The AR is interpreted as that fraction of disease in a population that would be avoided by reducing or
eliminating a known risk factor (Coughlin, et al., 1994). Knowing the AR can assist public health managers to choose between alternate disease prevention and health promotion strategies (Coughlin, et al., 1994).

Because this study was population based it was possible to calculate the attributable risk and the population attributable risk. The population attributable risk (PAR) is defined as the attributable risk multiplied by the proportion \( P_e \) of exposed individuals in the population (Hennekens et al., 1987).

\[
\text{PAR} = (\text{AR}) (P_e),
\]

It is in the analysis phase of the study where the role of confounding can be controlled for. Multi-variate analysis utilizes a mathematical model to efficiently and precisely estimate the effect of several variables simultaneously (Rothman, 1986). There are several different types of multi-variate analysis. The model chosen depends on the type of data being analyzed. If all of the variables under consideration are continuous then linear regression theories apply. However if the dependant variable is binary, with only two possible outcomes, then linear regression would provide an unstable estimate of the slope. Because presence or absence of NC is a binary variable, logistic regression will be used to study the role of confounding and the interaction between variables when the more elementary technique of stratification is impractical. The logistic model can be applied to the case-control study. The disease outcome is seen as the fixed, binary, variable and the exposure history is the random outcome.
Logistic regression is a powerful statistical tool for estimating the magnitude of the association between an exposure and outcome while adjusting simultaneously for a number of potential confounding factors (Rothman, 1986).

The equation used is
\[
\ln p_i = \mu + b_1x_{1i} + b_2x_{2i} + \ldots + b_kx_{ki} \quad \frac{1-p_i}{p_i}
\]

Where \( p_i \) is the probability of disease occurrence.
5. Results

5.1 Population Parameters

There have been approximately 7,300 live births, in North York, per year since 1986. The per cent of low birth weight infants has remained constant at approximately 6 per cent, which is higher than for the rest of Metropolitan Toronto. Children aged 0 to 4 years of age comprise 5.9 per cent of the population and those aged 5 to 9 years, 5.4 per cent of the population representing a total of 63,675 children under the age of ten years old (North York Public Health Department, 1995).

The City is divided, geographically, into three major health planning areas (HPA's), which are each sub-divided into two minor areas (See Figure 3). The planning areas are: East (North East, South East), West (North West, South West), Central (North Central South Central). The population is evenly distributed among the three major areas with 35 per cent in the East, 33 per cent in the Central and 32 per cent in the West. The West HPA has the greatest proportion of children, 26.2 per cent of the total population less than 19 years of age, and the greatest number of children less than 5 years of age. In 1991 53.3 per cent of the North York population were born in Canada. The West HPA also had the lowest proportion of people born in Canada, 48.3 per cent, compared to the East (55.4 per cent) and the Central (56.6 per cent). The proportion of non-immigrants has decreased in North York since 1986. In 1994 / 1995 the City was divided into five planning areas for the delivery of dental services.
was the North West, Area 2 was the South East, Area 3 was the North East, Area 4 was the South West, and Area 5 was the North and South Central areas combined.

A comparison of the total study population, and the three major health planning areas can be found in Appendix 2.

5.1.1 Schools Eligible For Screening

In 1994, in the city of North York, there were a total of 196 schools which had a Junior Kindergarten program. All of these schools are eligible for screening by the North York Public Health Department. One hundred and nine of these schools are from the North York Board of Education, 50 are from the Metropolitan Toronto Separate School Board, and 37 are independent schools. Based on projected service needs, the program manager divided the schools into three categories:

Category 1: All children are screened unless a written letter of exclusion is provided by the child's parent. Schools are considered to be in this category if more than five per cent of the total school population have dental service needs. There were 115 schools in Category 1.

Category 2: Only children in Senior Kindergarten and Grades 2, 4, 6, and 8 are offered screening. Schools are considered to be in this category if more than two per cent but less than five per cent of the total school population have dental service needs. There were 30 schools
in Category 2.

Category 3: Children are only screened following a request from the student or parent. Schools are considered to be in this category if less than two per cent of the total school population have dental service needs. There were 51 schools in Category 3.

5.2 Prevalence Data

Table 3 shows the prevalence of nursing caries in the screened population of children arranged by Health Planning Area. In total the North York Public Health Dental screening teams and the Principle Investigator screened 3,310 of the estimated 6,993 children enrolled in Junior Kindergarten. We identified 281 cases which was 8.6 per cent of those screened.

Although the prevalence by area ranged from 6.7 per cent in Area 2, to 10.7 per cent in Area 5 Chi-square analysis showed that there were no differences ($X^2=8.21$, df=4, p=0.08). While this is true, most of the cases came from Areas 1 and 4.

Table 4 shows the distribution of school types that were screened in each of the five Health Planning Areas, and the per cent of schools with identified cases. Overall 55.6 per cent of the 151 schools that were screened had one or more cases. A higher proportion (105 of 115) of Category 1 schools were screened, compared to the other two categories. This was because Category 1 was comprised of the higher risk schools.
By Area the proportion of schools screened ranged from 87 per cent of the schools in Area 1 to 44 per cent in Area 4. By category, the per cent of schools with one or more cases ranged from 33 per cent of Category 3 to 63 per cent of schools in Category 2. Only in two of the 15 Category-Area groupings were cases not found. No cases were found in the Category 2 schools in Area 1, and the Category 3 schools in Area 2.

Table 5 displays the number of cases identified per school, and the cumulative per cents of cases and schools. Overall the modal number of cases was 0. When considering only the schools where cases were identified, the modal number of cases was 1. The mean number of cases found in those schools where cases were identified was 3.9.

When looking at the cumulative per cent columns it can be seen that 50 per cent of the cases are found in 10 per cent of the schools. Each of these schools had six or more cases.

Table 6 represents the case type by school category within the Health Planning Areas. In total 76 per cent of the cases (82 per cent of active and 70.2 per cent of treated cases) were found in Category 1 schools. Twelve per cent of cases (10 per cent of active cases and 14.2 per cent of treated cases) were found in Category 2 schools, and 11.8 per cent of cases (8 per cent of active and 15.6 per cent of treated) were found in Category 3 schools.

We examined the distribution of active and treated cases found in the three types of school
categories using the Chi-square test. No significant differences were observed ($X^2=4.28$, df=2, $p=0.12$). As there were some Category-Area combinations which had no cases observed, we did not analyze the distribution of active and treated cases in each area.

Table 7 displays the distribution of active and treated cases by Health Planning Area. In total 66 per cent of the identified cases were active, untreated cases, and 34 per cent were treated cases identified by the absence, or treatment of two or more of the maxillary anterior teeth, and the response to the questionnaire. The proportion of active case in an Area ranged from 63 per cent in Area 2 to 72 per cent in Area 4. The proportion of treated cases per Area ranged from 28 per cent in Area 4 to 37 per cent in Area 2. When the proportion of case types found in health areas were compared no significant difference was observed ($X^2=2.44$, df=2, $p=0.65$).

5.3 Response to the Questionnaire

Table 8 summarizes the response of subjects to the mail-out. A total of 628 questionnaires were mailed out. Questionnaires were mailed out to all of the identified cases, and at least one of the control children chosen to correspond with each case. Of the cases, 79 (28 per cent) responded on the first mail out, 7 (4 per cent) on the second and 38 (20 per cent) on the third. One hundred and twenty-four were completed, of which 16 refused to participate. Eight of the completed case questionnaires were shown to be non-case children. These subjects were included with the control sample. One hundred and forty-one subjects (50 per cent) failed to
respond at all.

Of the control children ninety-nine positive responses were received. Seventy-three (21 per cent) responded on the first mail out, 10 (5.3 per cent) on the second and 25 (14 per cent) on the third. One hundred and eight were completed, 3 refused to participate, six were unusable, and 245 failed to respond. Of the returned responses, from control children, 99 were analyzed. In addition eight of the case children were redefined as controls as it was determined from the questionnaire responses that they were indeed not cases. Therefore there were a total of 107 control subjects in the final analysis (See Appendix 3).

Of the total, 22 questionnaires (4 per cent) were returned due to wrong addresses. These were subsequently hand delivered to the child's school.

After it became apparent that response to the questionnaire was poor, subjects were telephoned in an attempt to increase the response rate. Subjects were called on, up to, three occasions if contact could not be made. Eighty-nine phone calls were completed trying to encourage response to the questionnaire. Of these calls, three presented with definite language barriers, two were not in service, two definitely agreed to participate, three definitely refused to participate and the rest were non-committal.

In total the sample analyzed included 71 active cases, 29 treated cases and 107 control cases.
5.4 Results of the Cross-Tabulations

Table 9 displays the results of the analysis of the cases and controls from this study with respect to the potential risk factors identified in the Pilot Project. Only two of the risks; low family income and maternal birthplace were found to be statistically significant in this study. All of the other factors had 95 per cent confidence intervals that included unity, and p values greater than 0.05.

Of the total number of potential risks (67 variables) only 8 were found to be statistically significantly related to the development of nursing caries in this study population. The results of the cross-tabulation analysis can be found in Table 10. This table shows the per cent distribution of subjects with the risks for NC among controls, active and treated cases. The findings on each risk will be described in order, according to our classification of risk factors, determinants, and markers.

1. The Risk Factors

Dental Knowledge

When all of the cases were compared against the controls, with respect to their knowledge of things potentially harmful to a child's teeth, there was not a statistically significant difference observed between the groups ($X^2=18.0$, $df=12$, $p = 0.12$). The question to assess this
contained seven items. A cut-off point of three correct answers divided all study participants into a bottom quarter and top three quarters. Thirty-five per cent of the active cases, 21 per cent of treated cases and 17 per cent of controls answered fewer than three correctly. When only the active cases were compared to the controls, controls were more likely to respond correctly to three or more statements ($X^2=8.15, df=2, p=0.016$).

**Frequency of Brushing**

When the different case groups were compared against the controls there was a statistically significant difference was not observed between the groups, with respect to their reported frequency of brushing ($X^2=4.92, df=2, p=0.083$). Forty-eight per cent of active cases, 30 per cent of treated cases and 22 per cent of controls reported that they never brushed their child's teeth more than once per day. However, when only the active cases were compared to the controls there was a statistically significant difference seen between these two groups ($X^2=4.96, df=1, p=0.02$).
2. The Determinants

Mother's Birthplace

Eighty-four per cent of active cases, 66 per cent of treated cases and 66 per cent of controls had mothers born outside of Canada. When the responses to this variable were dichotomised to birthplace inside or outside of Canada a statistically significant difference was found between the different case groups and the controls ($X^2=7.86$, df=2, $p=0.02$). When active cases were compared with controls there was an even greater difference observed between the two groups ($p = 0.007$).

For all of the children in this study, 80 per cent of the fathers were born outside of Canada. This variable however was not found to be statistically different between the different study groups ($X^2=4.88$, df=2, $p=0.09$).

Child's Birthplace

Seventy-nine per cent of all of the children in this study were born in Canada. When the case groups were compared with the controls a statistically significant difference was observed between the groups based on the subjects birthplace ($X^2=7.43$, df=2, $p=0.02$). Thirty-one per cent of active cases, 10 per cent of treated cases and 17 per cent of controls were born outside of Canada. When active cases were compared with controls a statistically significant
difference was found between the groups ($X^2=4.91$, df=2, $p = 0.03$).

3. The Risk Markers

**Family Income**

The response rate for the question pertaining to family income was low. None the less when the case groups were compared with the controls there was a significant difference found between the groups based on reported family income ($X^2=24.7$, df=2, $p = 0.0000$). Of those responding 86 per cent of active cases, 57 per cent of treated cases and 36 per cent of controls reported total family incomes of less than $40,000.00.

**Dental Insurance**

When the case groups were compared against the controls, with respect to insurance coverage from work, there was a statistically significant difference observed between the groups ($X^2=11.9$, df=2, $p=0.003$). Seventy-six per cent of the active cases, 45 per cent of the treated cases and 53 per cent of the controls reported that their dental bills were not paid through workplace insurance.

When the groups were compared with respect to whether their dental costs were paid through government assistance there was a statistically significant difference observed ($X^2=9.9$, df=2,
p=0.006). Forty-eight per cent of the active cases, 11 per cent of the treated cases and 41 per cent of the controls had their dental bills paid through government assistance. When the active cases were compared to the controls the difference observed was statistically significant ($X^2=8.88$, df=1, p=0.002).

This relationship is understandable when one considers that the two groups; those with no insurance from work, and those with government assistance are not mutually exclusive and probably represent the same group of respondents.

Use of Dental Services

A lack of dental visiting by the child's father was statistically related to the development of nursing caries in the case children. Seventy-four per cent of the active cases, 59 per cent of the treated cases and 55 per cent of the controls reported that the father had not attended a dentist in the past year ($X^2=6.66$, df=2, p=0.04).

Reason for Child's First Dental Visit

When the case groups were compared with the controls there was a statistically significant difference between the two groups with respect to the reason for the child's first dental visit ($X^2=7.2$, df=2, p=0.03). Seventy-three per cent of the active cases, 69 per cent of the treated cases, and 54 per cent of the controls reported that the reason for the child's first dental
visit was for treatment. When active cases were compared to controls there was a statistically significant difference found ($X^2 = 7.17$, $df = 2$, $p = 0.03$).

**Primary Source of Child Care Information**

When all of the case groups were compared against the controls there was no difference found between the groups, with respect to their primary source of child care information ($X^2 = 5.7$, $df = 2$, $p = 0.06$). Fifty-six per cent of active cases, 36 per cent of treated cases and 38 per cent of controls used personal resources such as family members or friends as their primary source of child health information. When the active cases and controls were compared there was a statistically significant difference found ($X^2 = 4.92$, $df = 1$, $p = 0.03$). This variable was of interest as it was a variable under consideration in the Infant Feeding Practices Study done by the North York Department of Public Health. In this study they found that women, who reported that their primary source of support and information was professionals, actually breastfed for shorter periods of time.

**Combined Burden of Risk Factors**

A statistically significant difference was seen between the active cases and the controls when they reported having two or more risks ($X^2 = 9.47$, $df = 1$, $p = 0.002$).

There was no difference found between the groups with respect to the combined variables
related to feeding habits determined to be important in other studies.

Table 11 displays the birthplace data for the mothers of both cases and controls. The mothers responding to the questionnaire reported 38 different countries of birth. An attempt was made to group the countries according to the 1984 WHO Development Guidelines to determine if a statistically significant difference would be observed between the birthplace of the mother and the development of NC. When the groups were compared using the WHO guidelines no statistically significant difference was observed.

4. Other Factors Examined

Attendance at Pre-natal Classes

Of the variables found to be important in the pilot project, the final variable which was found to be important but not statistically significant was attendance at pre-natal classes. In the pilot study the issue of parental attendance was found to be a potential risk factor with an odds ratio of 2.17 (non significant 95% confidence interval). In the current study question N47 asked if the child’s parent attended pre-natal classes. They were given three possible responses: no; yes; don’t know. Twenty-six per cent of the active cases, 48 per cent of the treated cases and 40 per cent of the controls had parents who attended pre-natal classes. When all of the case groups were compared with the controls there was not a statistically significant difference observed. When the active cases were compared to the controls the difference observed was
close to being statistically significant ($X^2=5.6, df=1, p = 0.06$).

**Method of Feeding the Child**

Whether the child was bottle fed or breast fed did not have an influence on the development of nursing caries in the study groups ($X^2=0.72, df=2, p=0.69$). Seventy per cent of the total sample breast fed the child for some period of time, while 96 per cent of the sample reported having bottle fed the child. The duration of bottle feeding was not found to be statistically related to the development of nursing caries ($X^2=2.47, df=2, p=0.29$). Seventy-six per cent of the total sample reported weaning the child after the age of 24 months. Seven per cent of the sample, all control children, were still receiving the bottle at bed at five years of age. The duration of breast feeding did not have an affect on the development of nursing caries ($X^2=1.93, df=2, p=0.38$). Forty-three per cent of the sample weaned the child from the breast at less than six months of age. By twelve months 80 per cent of the sample children had been weaned from the breast. Only 4 per cent of the sample children were still being breast fed at 18 months of age. The use of a sweetened soother was not found to be significantly related to the development of nursing caries in this population. Thirteen per cent of the total sample reported the use of a sweetened soother, and these represented both cases and controls ($X^2=5.9, df=2, p=0.052$).
5.5 Results of the Risk Analysis

All of the risk factors, markers and determinants that were found to be statistically significant were analyzed using the Odds Ratio calculation to determine the relative strengths of the association between the exposure and the development of NC. The statistic to determine the significance of the association was the 95 per cent confidence interval. Table 12 displays the results of the risk analysis. Please note that the OR's reported are unadjusted. Again, the results will be described in order according to our classification of risk factors, determinants and markers.

1. The Risk Factors

Dental Knowledge

When all cases were compared to controls dental knowledge was seen to be related to the development of nursing caries with an odds ratio of 2.22 (95% C.I. = 1.09 < OR < 4.54). When only active cases were compared to controls dental knowledge was seen to be more strongly associated with the development of nursing caries as a higher odds ratio of 2.69 (95% C.I. = 1.26 < OR < 5.76) was observed. When treated cases were compared to controls a significant relationship was not observed.
Frequency of Brushing

Always brushing more than once a day was seen to be related to the development of active nursing caries with an odds ratio of 2.63 (95% C.I. = 0.90 < OR < 7.79). When those active cases and controls who reported never brushing on all three occasions offered in the question were compared to those that responded always brushing on at least one occasion, the habit of never brushing was seen to be related to nursing caries development with an odds ratio of 3.23 (C.I. 1.00 < OR < 10.65).

2. The Determinants

The odds ratios for the determinants were significant only when comparing active cases to the control group.

Mother's Birthplace

Maternal birthplace outside of Canada was found to be related to the development of active Nursing Caries with an odds ratio of 2.77 (95% C.I. = (1.23 < OR < 6.32).

Child's Birthplace

The child’s place of birth was found to be statistically related to their development of nursing
caries with an odds ratio of 2.22 (95% C.I. = 1.03 < OR < 4.82).

3. The Risk Markers

Odds ratios for the risk markers were significant only when active cases were compared to the control group. The only exception to this was for the variable ‘father’s lack of dental service use’.

Family Income

Income of less than $40,000 was found to be related to the development of active nursing caries with an odds ratio of 11.06 (95% C.I. = 3.62 < OR < 35.22).

Dental Insurance

Lack of insurance from work was seen to be related to the development of active nursing caries with an odds ratio of 2.78 (95% C.I. = 1.34 < OR < 5.84).

While not shown in the table, dependence on government assistance was also statistically related to the development of active nursing caries with an odds ratio of 2.63 (95% C.I. = 1.32 < OR < 5.27).
Use of Dental Services

A lack of dental visiting by the child's father was statistically related to the development of nursing caries with an odds ratio of 1.88 (95% C.I. 1.01 < OR < 3.48). When the active cases only were compared to the controls the odds ratio was 2.34 (95% C.I. 1.16 < OR < 4.79).

Reason for Child's First Dental Visit

When the case groups were compared with the controls, the reason for the child's first visit to the dentist was seen to be associated with their NC status with an odds ratio of 2.31 (95% C.I. = 1.15 < OR < 4.66).

Primary Source of Child Care Information

Attainment of health information from personal sources was seen to be related to nursing caries development with an odds ratio of 2.06 (95% C.I. = 1.03 < OR < 4.13).

Combined Burden of Risk Factors

Table 12 displays the results of the risk analysis when combined risks were examined. When active cases and the controls were compared based on reporting two or more risks, the odds
ratio was 2.71 (95% C.I. = 1.36 < OR < 5.42).

There was no statistically important difference found between the groups with respect to the combined variables related to feeding habits determined to be important in other studies.

4. Other Factors Examined

Not shown in any table, are the results of the analysis of some risks determined to be significant in the Pilot Project.

Non-Attendance at Pre-natal Classes

Non-attendance of prenatal classes was seen to be related to the development of nursing caries with an odds ratio of 1.92. The 95% confidence interval was not significant in this case ranging from 0.93 to 4.00.
Method of Feeding the Child

Whether the child was bottle-fed or breast-fed did not have an influence on the development of nursing caries in the study groups, the odds ratio was 0.79 (95% C.I. not significant). The duration of bottle-feeding was not found to be statistically related to the development of nursing caries, the odds ratio was 1.78 (95% C.I. not significant). The duration of breast-feeding did not have an affect on the development of nursing caries, the odds ratio was 1.39 (95% C.I. not significant). The use of a sweetened soother was not found to be associated with the development of nursing caries in this population. The odds ratio was 2.09 (95% C.I. not significant).

5.6 Results of the Multi-variate Analysis

All eight of the statistically significant single risk factors, markers and determinants identified from the cross-tabulation analysis were entered into a logistic regression model using a backwards step method with the SPSS program. The regression was run three times to establish the magnitude of association between case status and the statistically significant variables. From Table 13 it can be seen that when active cases were entered into the equation the variables found to be important were: low dental knowledge, the use of personal sources of information, and the father’s lack of dental service use. When the treated cases were entered only two variables remained as important, father’s utilization of dental services, and the lack of workplace dental insurance. When the total case group was entered the three variables found
to be important for the active cases, remained in the equation as significant; low dental knowledge, the use of personal sources of information, and the father's lack of dental service use. The accuracy of the equations is also noted on Table 13. The results with the highest accuracy are those comparing the treated with the control group. You will note that the models which were statistically significant were the models containing the active and treated case groups separately.

5.7 The Attributable Risk and Population Attributable Risk

The Attributable Risk was calculated using the odds ratio calculation for having low dental knowledge as determined by the logistic regression equation (See Figure 5). The AR was found to be 79.7 per cent for the active cases and 63 per cent for the total case group. The Population Attributable Risk was calculated using the total case group AR and the prevalence of having low dental knowledge in the control group (See Figure 5). The PAR was found to be 10.7 per cent.
6. Discussion of Results

The results of this study support our hypothesis, stated in Section 3.6, that there are socio-cultural and behavioural factors related to the development of nursing caries in the child population of North York.

The primary objectives of this study were to:

1) Establish an estimate of the prevalence of NC in the four year old population of North York.

2) Identify the risk factors, markers, and determinants for NC in this population.

We determined the prevalence of NC to be 8.6 per cent for the population of four year old children enrolled in junior kindergarten programs in North York schools, who were screened during the school year 1994/1995. It is important to note that due to logistical considerations within the Health Unit, not all of the children eligible for this study were indeed screened. If one considered all of the children eligible for screening as the denominator for the prevalence estimate the prevalence would be 4.0 per cent. From Table 4 it can be seen that in all but two of the Health Planning Areas, cases were observed in all three categories of schools. It is highly unlikely that indeed all of the cases of NC were found by the screening process, and therefore 4.0 per cent should be considered an under-estimate of the true prevalence. We are confident that 8.6 per cent represents the upper limit of the prevalence for this population as
our sample included all of the schools considered to be high risk, by the North York Public Health Department.

In a 1996 review article, Milnes reported on several prevalence studies done internationally. As discussed in his review, one of the major reasons for the diversity in prevalence estimates is the fact that there is no universally agreed upon definition for NC. The prevalence observed in this study is consistent with those observed in other studies. Assuming the true prevalence in North York to be between 4.0 and 8.6, it would be greater than that found by Derkson and Ponti (1982) in Vancouver (3.2 per cent). The prevalence in North York would be similar to that reported by Budowski (1989) in Toronto (7.4 per cent). Milnes suggests that the Derkson and Ponti (1982) estimate may be inaccurate in either direction due to the wide age range. The prevalence Derkson and Ponti report is for an entire population of children of several different ages and may not be comparable to other estimates for more clearly defined populations. Milnes notes that the Budowski estimate, of 7.4 per cent, is probably an artificially high figure due to non-random sampling. That study was done on children from ten, non-randomly selected day-care centres.

Our study addresses the shortcomings of both of these studies. The sample we are reporting on was a partial census of one age group rather than a cluster of one socio-economic strata or cultural group. However due to screening priorities, financially disadvantaged and immigrant groups may have been over-represented.
The second major objective was to identify the risk factors, markers and determinants for NC development in North York's child population. This objective was met by analyzing the differences in response to the questionnaire by both cases and controls.

The cases and controls in this study were different with respect to several attributes.

The attributes or exposures that increases the probability of the occurrence of disease, and which can be modified are called risk factors. The risk factors that we found to be significant in the cross-tabulation analysis were:

a) a lack of knowledge regarding dental health;

b) infrequent brushing of the child's teeth;

The attributes or exposures that increases the probability of occurrence of disease, and which cannot be modified are referred to as determinants. The determinants that we found to be significant in the cross-tabulation analysis were:

a) mothers born outside of Canada;

b) children born outside of Canada;

The attributes or exposures associated with the increased probability of occurrence of disease,
but which are not necessarily causal can be used as an indicator for the disease are called markers. From the cross-tabulation analysis we found the following to be markers for nursing caries:

a) total household income less than $40,000;

b) lack of dental insurance from work;

c) the child's father not utilizing dental services;

d) reliance on personal sources for health information regarding children;

The secondary objectives of this study were to:

1) To determine the relative risk, attributable risk and population attributable risks associated with the identified risk factors.

2) To examine parental awareness of the risks associated with certain bottle and breast feeding practices.

3) To examine patterns of dental service use, and preventive dental behaviours amongst these families and their influence on the development of NC in the young child;
4) To determine if any oral health care information is being disseminated to parents regarding NC.

5) To determine the sources of child oral health care information for these families;

1a) Lack of Knowledge

Parents of children with no nursing caries were found to have greater knowledge of things which were potentially harmful to children's teeth, for example giving a child a bed-time bottle with milk or juice.

In contrast Weinstein et al. (1992) found that two-thirds of parents with affected children reported having received previous information regarding the risks associated with NC development. Albert et al. (1988) found that over one-half of the parents whose children had NC reported that they were informed, prior to that child's birth, about NC. Both of these studies indicate that specific knowledge regarding NC did not alter those practices leading to the development of decay in those children. Our findings indicate that the parents of children without decay had a greater knowledge of factors related to oral health, and acted upon that knowledge.
In a population Head Start Children in the U.S.A., O'Sullivan and Tinanoff (1993) observed that 86 per cent of the NC cases took a bottle to bed. Of the children without NC, 69 per cent took a bottle to bed. Ninety per cent of the parents questioned knew that this was a bad thing to do. The investigators concluded that knowledge was not a factor in the infant feeding habits, however they acknowledged that parental knowledge may have changed between caries development and data collection.

The potential for this change in parental knowledge was also considered as a possibility in this study. Although a statistically significant difference was found between cases and non-cases, the magnitude of the effect may have been attenuated due to a change in knowledge between case identification and data collection.

1b) Infrequent Brushing

Among the participants in this study, a history of infrequent brushing was seen to be related to NC development. There is not a lot of information available in the literature specifically related to brushing and development of this type of caries, as most of the research has been focused on infant feeding practices. Weinstein et al. (1996) did include brushing frequency as a variable in their study. Although not found to be statistically significant it did appear to be related to ethnicity, and the presence of other children in the home. They point out that it is important to remember that tooth brush and tooth paste may indeed be foreign to some cultural groups, and that some groups may benefit from training in the use of tooth brush and tooth
· paste as part of a prevention plan.

1c) Infant Feeding Practices

Our findings indicate that for this population the method of infant feeding (bottle or breast) was not related to the development of nursing caries in the North York population. This finding is similar to findings in other studies, Roberts et al. (1994) and Matee et al. (1994). In both of these studies the method of infant feeding was not found to be related to the development of nursing caries. In both of these studies however the duration of breast feeding (Roberts et al. 1994) and the habit of allowing the infant to fall asleep at night at the breast (Matee et al. 1994) were found to be significantly related to the development of nursing caries in infants. In our study we were unable to show a statistically significant relationship between the duration of either breast feeding, or bottle feeding and the development of this type of decay. We did not specifically investigate the type of nocturnal breast feeding examined in the study by Matee et al. (1994).

In a study by Bernard-Bonnin et al. (1993) the average age of weaning from a bottle was found to be 14.6 months. They found that after 18 months of age, children from minority ethnic groups were more frequently bottle fed (p < .005). In our study, the average age of weaning from a bottle was found to be 29 months for the entire population. The active cases were weaned at an average of 31 months, the treated cases at 30 months and the controls at 28 months. Bernard-Bonnin et al. (1993) also found that less educated mothers, and those from
minority ethnic groups were more likely to give a child the bottle in bed (p = .007).

One area of controversy with respect to the investigation of this type of decay, is the need to establish an appropriate taxonomy. Historically, decay in young children has been referred to by many different names. The most common are Baby Bottle Tooth Decay, Nursing Caries and, increasingly, Early Childhood Caries. One of the arguments against the first two terms is that they imply a specific etiology for the decay. In the first, the baby bottle is blamed solely for the development of decay. Although it was not the intention, the term Nursing Caries seems to implicate breast-feeding as a predominate etiological agent in this type of decay. As a means of alleviating these difficulties the term Early Childhood Caries has become more popular. The problem with this term is that it does not describe the type of caries in a way which distinguishes it from any other type of decay.

This study was unable to show a statistically significant relationship between infant feeding practices and decay development. Because of this we consider that it would be most appropriate for us to refer to decay in the young child population of North York as Early Childhood Caries.
Another factor found to be significantly related to the development of NC in this population was the birthplace of the mother. Seventy-seven per cent of the mothers for the total respondent sample for this study were born outside of Canada. This is greater than amongst the general population of North York, and greater than we found in our pilot project. In the pilot, the study group was not randomly selected and was composed of families where both parents were working, therefore necessitating the child's attendance at a day-care centre. In this study, we screened 90 per cent of all of the children enrolled in Junior Kindergarten, and then included only those with nursing caries and two others from the same class as controls. In this way we have clusters of children from different parts of the city.

We found in the pilot study that maternal education was an important factor in the development of nursing caries, however in the current study this was not an issue. The main reason for this was the high level of education achieved by immigrants. Of the mothers born outside of Canada, 55.4 per cent were college or university educated.

In most of the studies of NC, maternal and child birthplace was seen to be related to the development of decay. Immigrant families were seen to have higher rates of NC in the 'Camden' studies, in Great Britain, in a study from Turkey (Eronet and Eden, 1992), and in a study from Norway (Holm, 1990; Holt et al. 1982, 1988). This lower level of dental health amongst immigrant children is probably related to their families generally lower socio-
economic level and their limited access to basic health services due to language and other cultural barriers. It is possible that ethno-cultural factors not only limit access to care but influence the choice of health information resource.

3 a,b) Dental Insurance, Income, and the Father's Utilization of Dental Services

In Canada most health care is provided through universal insurance programs funded by the Federal and Provincial governments. Dental needs however are privately paid for on a fee for service basis by the general population, and often this is through pre-paid insurance benefits from the work-place. While some provincial and municipal programs provide dental care for children, seniors and welfare recipients ( Locker, Leake, 1993), approximately 60 per cent of the Ontario population reports having dental insurance funded by employers as an employment benefit. The Community Dental Health Services Research Unit at the University of Toronto Faculty of Dentistry has conducted several studies which have looked at the causes for inequities in oral health status amongst Ontarians.

For example, an analysis of the data from the 1990 Ontario Health Survey used a self completed mail survey to assess the health needs and the utilization of health services by the general Ontario population. It was found that serious inequities in oral health, related to an individuals income and dental insurance coverage exist in Ontario. People in lower socio-economic levels, and those without dental insurance were more likely to lose all of their teeth,
wear a prosthesis, report oral symptoms (such as pain, or difficulty chewing), and were less likely to have visited a dentist within the last year. The cost of visiting the dentist was the most frequent reason cited for not utilizing dental services (Jokovic, Locker, 1995). These results support what has been termed 'the inverse care law' (Hart, 1971). Those individuals with the greatest needs, low income and those without dental insurance, have the least access to care. This relationship has been found for adolescents, adults and the elderly in different areas of the province. In the population of North York, the inverse relationship between income, dental insurance and the need for services was also observed (Jokovic, Locker, 1995).

In our study population, a child that developed nursing caries was more likely to have come from a family with lower income, and a lack of dental insurance. These families reported they utilized dental services to a lesser extent. A higher proportion of the families, with nursing caries children, attended for emergency care rather than for routine dental services. The families with children who had extensive dental caries, had the least economic access to dental treatment. In contrast, those families in which the father utilized dental services regularly, there was a lower odds of the child developing Nursing Caries. We hypothesize that this is another reflection of the role of socio-economic status on oral health. In general, our results support a Materialist / Structuralist Explanation for the inequities in health, as described by Locker (1989). In our population those variables related to socio-economic status indicated that there was an increased risk for the development of an adverse health outcome (Nursing Caries) for those people with fewer resources.
3 d) Source of Health Care Information

This variable was included in the study as it had been found to be a significant factor in a study of infant feeding habits in North York. In that study, women who reported using professional sources of information were less likely to breast-feed for longer periods of time (unpublished data). In this study we found that professional sources of information were related to better oral health for the young child. Specifically, although there was no statistically significant relationship observed between the mother's birthplace and the source of information \((p=0.08)\), it is possible that the families relying on personal sources of information do so because language or cultural barriers which make access to accurate professional information difficult.

Logistic Regression

The logistic regression was run three times to establish the association between case status and the significant exposures. In the equation, seven of the eight statistically significant variables were entered. The count variable relating to brushing frequency was not included as we were not confident that it was accurately answered by the respondents. The data for this variable had several missing values which we felt would compromise the validity of the logistic regression.

When the total case group was entered into the logistic regression equation with the eight variables, the final equation included low dental knowledge, use of personal sources of
information and the father's lack of dental service use as significant. The overall accuracy of this model was 63 per cent. The model was not statistically significant (-2 Log Likelihood 176.2, df=135, p=.01). This failure to reach statistical significance could be related to a small sample size, and the attenuating effect that the treated cases had on the overall results.

The final equation for the model containing the treated case group and the eight variables garnered interesting results. The father's lack of dental service use was a significant risk factor. The lack of workplace dental insurance was found to be a preventive factor. This is reasonable, as those case children whose parents had dental insurance were most likely to be amongst the treated cases. Having dental insurance therefore, was a risk for those children being treated for their nursing caries. The accuracy of this model was 77 per cent and the model was found to be statistically significant (-2 Log Likelihood 97.2, df=93, p=0.36).

The final logistic regression equation for the active cases contained the same variables as the total case group; low dental knowledge, personal sources of information, and the father's lack of dental service use. For all three variables the odds ratio reflected a greater magnitude of association than for the total case group. We feel that this reflects the confounding effect that the treated cases had on the analysis of this study. The overall accuracy of this model was 70 per cent, and the model was found to be statistically significant (-2 Log Likelihood 131.6, df=113, p=0.11).
Attributable Risk

Because this study was population based it was possible to calculate the attributable risk and the population attributable risk. The attributable risk (AR) measures the excess risk of disease in individuals exposed compared to those non-exposed. The AR is defined as the difference in the incidence rates in the exposed and non-exposed groups. Knowing the AR can assist public health managers to choose between alternate disease prevention and health promotion strategies (Coughlin, et al., 1994).

In the analysis of this study we used the variable of having low dental knowledge as the basis for the AR calculation. This was chosen as it represented a reasonable basis for the development of a health promotion, disease prevention strategy. A public health strategy would be most useful, and cost effective, if it addressed more than one isolated risk factor, such as bottle feeding habits or oral hygiene.

The odds ratio used for this calculation was that determined from the logistic regression. The prevalence of this variable in the control group was used as the multiplier in the calculation. When active cases were considered the AR was found to be 79.7 per cent. When the total case group was considered the AR was found to be 63.1 per cent (See Figure 5).

The population attributable risk (PAR) was calculated using the prevalence of having low dental knowledge in the control group (17 per cent). Therefore the PAR for this population is
10.7 per cent (See Figure 5).

The Role of Bias in the Results

From the results of this study, bias in responding to the questionnaire likely played a significant role in the findings. Many of the variables traditionally found to be associated with this condition were not found to be significant with respect to this population. Further, of the eight risks found to be important in the pilot project, only three were found to be significant in this study (See Table 12).

We hypothesize that some of the differences, between the results of the pilot project, other studies in this area and this current study, are related to the time interval between the screening examinations and the administration of the questionnaire.

In the pilot project, parents were given the questionnaire to complete prior to the child being examined. In most cases the child had never been to a dentist before. In the present study, the children were examined, their case status determined, and then the questionnaire administered. There was a time lag, between case identification and the administration of the questionnaire. For most of the schools screened this was a few weeks, however for some the time between identification and receiving the survey was a few months. Because of this, the parents became aware of their child's dental condition, and some had taken their child to a dentist, where they may have obtained treatment and been given information regarding NC. This may have
biased their responses, such that when they completed the questionnaire they knew the "correct" answers.

The variables which were most strongly affected by social desirability bias were those related to infant feeding practices. We postulate that the cases were informed by dentists which specific feeding behaviours had caused their child's problems and therefore which of their parenting decisions had been wrong. In an attempt to decrease the possibility of this we asked the respondents, in the covering letter, to answer the survey based on their experiences and not what they thought the correct answer was.

In the study by Visser et al. (1994) it was found that social desirability tendency occurred to a greater extent when subjects answered questions about responsibility for their oral health, and not questions regarding dental knowledge, information sources and oral hygiene behaviours. These researchers felt that these represent cognitive facts and not behaviours which the subjects felt they needed to present in a more positive way. In this study social desirability bias occurred to a greater extent with the variables related to feeding habits, but not with respect to those related to knowledge, information sources, and demographic issues such as education and income. It is likely that these issues were more factual in nature and therefore the respondents did not feel compelled to alter their replies to a more socially favourable response.
Response Bias

The overall response rate for this study was 33 per cent. This is less than other studies conducted in North York recently.

Fifty per cent of case parents participated in the study. It is possible that the decreased response rate, amongst cases was related to social desirability as they may have felt guilty or embarrassed about their child’s condition, and did not wish to acknowledge it publicly. During phone calls to solicit participation many mothers expressed this sentiment. Several reported that the entire experience had been difficult and that they did not wish to re-visit it.

With respect to the control children the lack of response is more troublesome, and probably reflects a lack of interest. Only twenty-four per cent participated in the study. As their children did not have the need for dental care these families may not have felt the need to participate in research focused on improving services for children in need.

We were not able to accurately analyze the response bias with respect to immigration status as we only had the family surname to estimate ethnicity for non-responders. There was no means for the researchers to obtain the information necessary to establish if response and non-response bias were related to immigration status..
Selection Bias

Other forms of selection bias may have been involved in the results of this study. Selection bias occurs during the design phase of the study and cannot be subsequently controlled for during analysis. This type of bias results from the way in which the sample groups were chosen. In case-control studies selection bias occurs when the cases and controls are chosen based on different criteria (Choi and Noseworthy, 1992). Bias can occur in either direction, thereby increasing or decreasing the estimated magnitude of the relationship between the exposure and the disease.

Berkson's bias, also known as hospital bias, refers to bias incorporated into the study by choosing participants from only one type of institution. In this study there was a greater proportion of children from high risk schools. This was due to the screening priorities of the North York Public Health Department. However, cases and controls were also chosen from several different schools, from both public and separate school boards, as well as from privately funded institutions. It is possible that the over-representation of high risk schools biased the results.

Neyman's bias occurs when there is a time lag between the diagnosis of the disease and recruitment for the study. It is conceivable that due to a time lag between screening and recruitment that some cases or controls may have moved or change schools and therefore were lost to the study.
Membership bias may have been a source of bias in this study. Those children who were not enrolled in school, because of extenuating medical or social reasons were not included in the sample population. This would have had the effect of biasing the results toward unity as these children may have been at increased risk for nursing caries.

Sample Size Calculation

As noted in Section 4.8 the sample size was calculated using the EPI INFO statistical package. It was estimated that a total sample of 111 cases and 111 controls would be required, based on the assumption of a 4 per cent prevalence. In Appendix 4, the minimum sample size, based on the known OR's and prevalence from this study, are tabulated. It can be seen that the sample had adequate power with respect to four of the eight variables.

Internal and External Validity

The fact that the observed prevalence is less than 10 per cent supports our decision to utilize the case control methodology. As discussed in Section one of the prime indicators for the use of the Case Control methodology is relatively low prevalence.
7. Conclusions

For the study population the following risks were found to be statistically related to the development of nursing caries:

1) A lack of knowledge about dental health;

2) The reliance on personal sources of health information;

3) The lack dental services utilization of the child’s father;

Based on the PAR calculation it can be estimated that approximately 10.7 per cent of NC cases in the at risk four year old population of North York could be eliminated by eliminating the known modifiable risk factor of low dental knowledge.
8. Implications for the North York Public Health Department

The results of this study indicate that more information from professional sources, regarding child oral health, needs to be accessible to the general population of North York.

The changing demographics of the North York population is impacting on the need for delivery of health services in multiple languages and in ways that are accessible to new immigrants. Because different groups have culture specific views on health, and child rearing, research needs to be done to focus on parents beliefs about child rearing in order to effectively promote good child health. Dental treatment and health promotion services need to continue to be provided for those families in North York that can not afford to obtain them privately. As determined by this study a lack of dental insurance from work is related to the development of this condition. When families can not afford to obtain treatment the cost of the care is borne by the Provincial government through the C.I.N.O.T. programme. In a study by Cook et al. (1994) it was found that the average cost of treating a child with nursing caries, who required general anaesthetic was $2,141.75. The average cost for one child, not requiring general anaesthesia was $311.55. It would be a wise investment for the future, for health units and the Provincial government, to promote research into the prevention of nursing caries specifically and the promotion of oral health generally in young children.
Further research into this area would be most useful if it were conducted using a prospective study design. In this way the true relationship between factors such as bottle and breast feeding and the development of nursing caries could be observed, without the potential for recall or social desirability bias affecting the results.
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>YEAR OF PUBLICATION</th>
<th>INVESTIGATOR</th>
<th>REPORTED PREVALENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRITAIN</td>
<td>1966</td>
<td>Winter, et al.</td>
<td>12.0%</td>
</tr>
<tr>
<td></td>
<td>1968</td>
<td>Goose and Gittus</td>
<td>5.9%</td>
</tr>
<tr>
<td></td>
<td>1971</td>
<td>Winter, et al.</td>
<td>8.0%</td>
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<tr>
<td></td>
<td>1982</td>
<td>Holt, et al.</td>
<td>3.1%</td>
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<tr>
<td>UNITED STATES</td>
<td>1976</td>
<td>Powell</td>
<td>1.0%</td>
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<tr>
<td></td>
<td>1984</td>
<td>Johnsen, et al.</td>
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<td></td>
<td>1987</td>
<td>Kelly and Bruerd</td>
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<td>CANADA</td>
<td>1982</td>
<td>Derksen and Ponti</td>
<td>3.2%</td>
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TABLE 2:

POTENTIAL RISK FACTORS FOR NC IN THE NORTH YORK PRE-SCHOOL POPULATION.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds Ratio</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetened soother</td>
<td>6.46</td>
<td>(1.54 &lt; OR &lt; 27.09)</td>
</tr>
<tr>
<td>Milk in bottle</td>
<td>5.00</td>
<td>(.58 &lt; OR &lt; 41.3)</td>
</tr>
<tr>
<td>Mother's education highschool or less</td>
<td>4.13</td>
<td>(1.03 &lt; OR &lt; 16.6)</td>
</tr>
<tr>
<td>Bottle when crying</td>
<td>3.92</td>
<td>(.99 &lt; OR &lt; 15.51)</td>
</tr>
<tr>
<td>Bottle in crib</td>
<td>3.64</td>
<td>(.46 &lt; OR &lt; 28.80)</td>
</tr>
<tr>
<td>Pre-natal classes non-attendance</td>
<td>2.17</td>
<td>(.24 &lt; OR &lt; 26.73)</td>
</tr>
<tr>
<td>Family income Less than $40,000</td>
<td>1.46</td>
<td>(.28 &lt; OR &lt; 7.70)</td>
</tr>
<tr>
<td>Mother's birthplace outside of Canada</td>
<td>1.26</td>
<td>(.31 &lt; OR &lt; 5.09)</td>
</tr>
</tbody>
</table>

SOURCE: These are the results of the Pilot Project performed by Dr. P.L. Abbey and Dr. A. Jokovic. This study was a cross-sectional survey of 24 day-care centres in North York.
<table>
<thead>
<tr>
<th>AREA</th>
<th>TOTAL NUMBER OF CHILDREN AVAILABLE</th>
<th>NUMBER OF CHILDREN SCREENED</th>
<th>NUMBER OF CASES IDENTIFIED</th>
<th>PER CENT PREVALENCE IN SCREENED POPULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA 1</td>
<td>1,751</td>
<td>830</td>
<td>78</td>
<td>9.4</td>
</tr>
<tr>
<td>AREA 2</td>
<td>777</td>
<td>361</td>
<td>24</td>
<td>6.7</td>
</tr>
<tr>
<td>AREA 3</td>
<td>957</td>
<td>454</td>
<td>34</td>
<td>7.5</td>
</tr>
<tr>
<td>AREA 4</td>
<td>2,223</td>
<td>1,049</td>
<td>79</td>
<td>7.5</td>
</tr>
<tr>
<td>AREA 5</td>
<td>1,285</td>
<td>616</td>
<td>66</td>
<td>10.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6,993</td>
<td>3,310</td>
<td>281</td>
<td>8.6</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 8.2 \text{ df } = 4 \text{ p } = 0.08 \]
### TABLE 4:

PROPORTION OF SCHOOLS WITH IDENTIFIED CASES OF NURSING CARIES BY CATEGORY OF SCHOOL AND HEALTH PLANNING AREA.

<table>
<thead>
<tr>
<th>AREA AND NUMBER OF SCHOOLS</th>
<th>Category One</th>
<th>Category Two</th>
<th>Category Three</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AREA 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>15</td>
<td>4</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>15</td>
<td>1</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>87</td>
<td>0</td>
<td>0</td>
<td>87</td>
</tr>
<tr>
<td><strong>AREA 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>19</td>
<td>3</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>18</td>
<td>2</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>33</td>
<td>100</td>
<td>0</td>
<td>66.5</td>
</tr>
<tr>
<td><strong>AREA 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>28</td>
<td>10</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>26</td>
<td>5</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>35</td>
<td>60</td>
<td>43</td>
<td>46.0</td>
</tr>
</tbody>
</table>

*table continued on next page*
TABLE 4 continued:

PROPORTION OF SCHOOLS WITH IDENTIFIED CASES OF NURSING CARIES BY CATEGORY OF SCHOOL AND HEALTH PLANNING AREA.

<table>
<thead>
<tr>
<th>AREA AND NUMBER OF SCHOOLS</th>
<th>Category One</th>
<th>Category Two</th>
<th>Category Three</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>35</td>
<td>8</td>
<td>18</td>
<td>61</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>30</td>
<td>5</td>
<td>12</td>
<td>47</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>43</td>
<td>40</td>
<td>50</td>
<td>44.3</td>
</tr>
<tr>
<td>AREA 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>18</td>
<td>5</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>75</td>
<td>100</td>
<td>50</td>
<td>75.0</td>
</tr>
<tr>
<td>CITY OF NORTH YORK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL NUMBER OF SCHOOLS</td>
<td>115</td>
<td>30</td>
<td>51</td>
<td>196</td>
</tr>
<tr>
<td>NUMBER OF SCHOOLS SCREENED</td>
<td>105</td>
<td>16</td>
<td>30</td>
<td>151</td>
</tr>
<tr>
<td>PER CENT OF SCHOOLS WITH IDENTIFIED CASES</td>
<td>51</td>
<td>63</td>
<td>33</td>
<td>55.6</td>
</tr>
</tbody>
</table>
TABLE 5:

DISTRIBUTION OF SCHOOLS ACCORDING TO NUMBER OF CASES IDENTIFIED.

<table>
<thead>
<tr>
<th>CASES PER SCHOOL</th>
<th>NUMBER OF SCHOOLS WITH X CASES</th>
<th>CUMULATIVE PER CENT OF CASES</th>
<th>CUMULATIVE PER CENT OF SCHOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>74</td>
<td>0</td>
<td>50.3</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
<td>6.4</td>
<td>62.6</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>17.1</td>
<td>72.8</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>32.0</td>
<td>82.3</td>
</tr>
<tr>
<td>4</td>
<td>.6</td>
<td>40.5</td>
<td>86.4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>49.5</td>
<td>89.8</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>51.6</td>
<td>90.5</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>61.6</td>
<td>93.2</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>64.4</td>
<td>93.9</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>67.6</td>
<td>94.6</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>71.2</td>
<td>95.3</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>79.0</td>
<td>96.7</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>83.6</td>
<td>97.4</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>88.6</td>
<td>98.1</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>93.1</td>
<td>98.8</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>100</td>
<td>99.5</td>
</tr>
</tbody>
</table>
TABLE 6:

DISTRIBUTION OF NURSING CARIES CASE TYPE BY HEALTH PLANNING AREA AND SCHOOL CATEGORY

<table>
<thead>
<tr>
<th>AREA / SCHOOL TYPE</th>
<th>ACTIVE CASES (%)</th>
<th>TREATED CASES (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AREA 1</strong> n=54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>AREA 2</strong> n=15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>67</td>
<td>78</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>33</td>
<td>22</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>AREA 3</strong> n=22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>36</td>
<td>17</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td><strong>AREA 4</strong> n=57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>75</td>
<td>46</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td><strong>AREA 5</strong> n=44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>89</td>
<td>77</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td><strong>TOTAL</strong> n=192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 1 Schools</td>
<td>82</td>
<td>70</td>
</tr>
<tr>
<td>Category 2 Schools</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Category 3 Schools</td>
<td>8</td>
<td>16</td>
</tr>
</tbody>
</table>

$X^2 = 4.28$ df=2 p=0.12
TABLE 7:

DISTRIBUTION OF ACTIVE AND TREATED CASES BY HEALTH PLANNING AREA

<table>
<thead>
<tr>
<th>AREA</th>
<th>ACTIVE CASES (%)</th>
<th>TREATED CASES (%)</th>
<th>TOTAL CASES (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>69</td>
<td>31</td>
<td>78</td>
</tr>
<tr>
<td>2</td>
<td>63</td>
<td>37</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>64</td>
<td>36</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>28</td>
<td>79</td>
</tr>
<tr>
<td>5</td>
<td>67</td>
<td>33</td>
<td>66</td>
</tr>
<tr>
<td>TOTAL</td>
<td>66</td>
<td>34</td>
<td>281</td>
</tr>
</tbody>
</table>

$X^2 = 2.44$ df=2 p=0.65
TABLE 8:

RESPONSE RATES FOR QUESTIONNAIRE MAIL-OUT

<table>
<thead>
<tr>
<th>MAILING STAGE</th>
<th>CASES</th>
<th>CONTROLS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST (n)</td>
<td>(281)</td>
<td>(347)</td>
<td>(628)</td>
</tr>
<tr>
<td>RESPONDED</td>
<td>28.1</td>
<td>21.0</td>
<td>24</td>
</tr>
<tr>
<td>SECOND (n)</td>
<td>(187)</td>
<td>(187)</td>
<td>(374)</td>
</tr>
<tr>
<td>RESPONDED</td>
<td>3.7</td>
<td>5.3</td>
<td>4.54</td>
</tr>
<tr>
<td>THIRD (n)</td>
<td>(179)</td>
<td>(179)</td>
<td>(358)</td>
</tr>
<tr>
<td>RESPONDED</td>
<td>21.2</td>
<td>14.0</td>
<td>17.5</td>
</tr>
<tr>
<td>TOTAL RETURNED</td>
<td>50</td>
<td>31</td>
<td>37</td>
</tr>
<tr>
<td>TOTAL SAMPLE</td>
<td>(100)</td>
<td>(107)</td>
<td>(207)</td>
</tr>
<tr>
<td>OVERALL RESPONSE RATE</td>
<td>38.4</td>
<td>28.5</td>
<td>33</td>
</tr>
</tbody>
</table>
TABLE 9:

PER CENT OF CASES AND CONTROLS WITH THE POTENTIAL RISK FACTORS IDENTIFIED IN THE PILOT STUDY.

<table>
<thead>
<tr>
<th>RISK FACTORS DERIVED FROM PILOT</th>
<th>PER CENT OF ALL CASES WITH RISK (n)</th>
<th>PER CENT OF CONTROL CASES WITH RISK (n)</th>
<th>ODDS RATIO</th>
<th>95 % CONFIDENCE INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used Sweetened Soother</td>
<td>16 (93)</td>
<td>11 (105)</td>
<td>1.49</td>
<td>.61 &lt; OR &lt; 3.64</td>
</tr>
<tr>
<td>Gave Milk in the Bottle in Crib</td>
<td>56 (94)</td>
<td>58 (96)</td>
<td>0.92</td>
<td>.51 &lt; OR &lt; 1.64</td>
</tr>
<tr>
<td>Low Maternal Education</td>
<td>23 (94)</td>
<td>20 (101)</td>
<td>0.79</td>
<td>.4 &lt; OR &lt; 1.56</td>
</tr>
<tr>
<td>Gave Bottle When Child Crying</td>
<td>87 (53)</td>
<td>77 (44)</td>
<td>1.93</td>
<td>.60 &lt; OR &lt; 6.36</td>
</tr>
<tr>
<td>Gave Bottle in Crib</td>
<td>74 (93)</td>
<td>62 (103)</td>
<td>1.75</td>
<td>0.91 &lt; OR &lt; 3.38</td>
</tr>
<tr>
<td>Non-Attendance at Pre-Natal Classes</td>
<td>66 (91)</td>
<td>59 (103)</td>
<td>1.33</td>
<td>0.71 &lt; OR &lt; 2.5</td>
</tr>
<tr>
<td>Low Family Income - less than $40,000</td>
<td>86 (50)</td>
<td>36 (42)</td>
<td>5.93</td>
<td>2.39 &lt; OR &lt; 14.94</td>
</tr>
<tr>
<td>Mother's Birthplace Outside of Canada</td>
<td>84 (100)</td>
<td>65 (107)</td>
<td>2.77</td>
<td>1.23 &lt; OR &lt; 6.35</td>
</tr>
</tbody>
</table>
TABLE 10:

PER CENT OF SUBJECTS RESPONDING TO THE EIGHT VARIABLES FOUND TO BE STATISTICALLY SIGNIFICANT WITH RESPECT TO THE DEVELOPMENT OF NURSING CARIES IN THE FOUR-YEAR-OLD POPULATION OF NORTH YORK.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>ACTIVE CASES (n)</th>
<th>TREATED CASES (n)</th>
<th>CONTROLS (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DENTAL KNOWLEDGE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Knowledge</td>
<td>35 (71)</td>
<td>21 (29)</td>
<td>17 (107)</td>
</tr>
<tr>
<td><strong>BRUSHING FREQUENCY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>only brushed zero or one time per day</td>
<td>48 (25)</td>
<td>30 (10)</td>
<td>22 (45)</td>
</tr>
<tr>
<td><strong>SOURCE OF INFORMATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>personal sources of information</td>
<td>56 (63)</td>
<td>36 (28)</td>
<td>38 (98)</td>
</tr>
<tr>
<td><strong>MOTHER'S BIRTHPLACE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>outside of Canada</td>
<td>84 (71)</td>
<td>66 (29)</td>
<td>66 (107)</td>
</tr>
<tr>
<td><strong>CHILD'S BIRTHPLACE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>outside of Canada</td>
<td>31 (71)</td>
<td>10 (29)</td>
<td>17 (107)</td>
</tr>
</tbody>
</table>

Table 10 Continued on next page
TABLE 10 continued:

PER CENT OF SUBJECTS RESPONDING TO THE EIGHT VARIABLES FOUND TO BE STATISTICALLY SIGNIFICANT WITH RESPECT TO THE DEVELOPMENT OF NURSING CARIES IN THE FOUR-YEAR-OLD POPULATION OF NORTH YORK.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>ACTIVE CASES (n)</th>
<th>TREATED CASES (n)</th>
<th>CONTROLS (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY INCOME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than $39,999</td>
<td>86 (50)</td>
<td>57 (23)</td>
<td>36 (42)</td>
</tr>
<tr>
<td>WORKPLACE DENTAL INSURANCE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>76 (67)</td>
<td>45 (29)</td>
<td>53 (103)</td>
</tr>
<tr>
<td>FATHER'S USE OF DENTAL SERVICES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not a regular user</td>
<td>74 (69)</td>
<td>59 (29)</td>
<td>55 (106)</td>
</tr>
<tr>
<td>REASON FOR THE CHILD'S FIRST VISIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatment</td>
<td>73 (71)</td>
<td>69 (29)</td>
<td>54 (107)</td>
</tr>
</tbody>
</table>
TABLE 11:

MATERNAL BIRTHPLACE OF RESPONDANTS ACCORDING TO THE WHO DEVELOPMENT GUIDELINE FROM 1984

<table>
<thead>
<tr>
<th>DEVELOPMENT LEVEL</th>
<th>PER CENT OF ACTIVE CASES n=71</th>
<th>PER CENT OF TREATED CASES n=29</th>
<th>PER CENT OF CONTROLS n=107</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed</td>
<td>22</td>
<td>48</td>
<td>45</td>
</tr>
<tr>
<td>Developing</td>
<td>71</td>
<td>48</td>
<td>54</td>
</tr>
<tr>
<td>Least Developed</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Outside of Canada</td>
<td>84</td>
<td>65</td>
<td>66</td>
</tr>
<tr>
<td>VARIABLE</td>
<td>CASES vs CONTROLS</td>
<td>ACTIVE CASES vs CONTROLS</td>
<td>TREATED CASES vs CONTROLS</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td><strong>RISK FACTORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor dental knowledge</td>
<td>2.22*</td>
<td>2.69**</td>
<td>1.29</td>
</tr>
<tr>
<td>Infrequent brushing</td>
<td>2.63</td>
<td>3.23*</td>
<td>1.50+</td>
</tr>
<tr>
<td><strong>RISK MARKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low family income</td>
<td>5.93**</td>
<td>11.06**</td>
<td>2.34</td>
</tr>
<tr>
<td>Lack of workplace dental insurance</td>
<td>1.75</td>
<td>2.78**</td>
<td>0.71</td>
</tr>
<tr>
<td>Father’s lack of dental service use</td>
<td>1.88*</td>
<td>2.34*</td>
<td>1.17</td>
</tr>
<tr>
<td>Personal source of health information</td>
<td>1.61</td>
<td>2.06*</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>DETERMINANTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s birthplace outside of Canada</td>
<td>1.91</td>
<td>2.77*</td>
<td>0.96</td>
</tr>
<tr>
<td>Child’s birthplace outside of Canada</td>
<td>1.65</td>
<td>2.22*</td>
<td>0.57+</td>
</tr>
</tbody>
</table>

Table 12 continued on next page
TABLE 12 continued:

ODDS RATIOS FOR THE EIGHT VARIABLES FOUND TO BE STATISTICALLY SIGNIFICANT.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>CASES vs CONTROLS</th>
<th>ACTIVE CASES vs CONTROLS</th>
<th>TREATED CASES vs CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTHER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has two or more combined risks</td>
<td>2.26*</td>
<td>2.71**</td>
<td>1.40</td>
</tr>
<tr>
<td>Child's first dental visit was for treatment</td>
<td>2.17*</td>
<td>2.31*</td>
<td>1.88</td>
</tr>
</tbody>
</table>

No asterisk = non-significant p value and 95% confidence interval
* = p value is less than or equal to 0.05, and the 95% confidence interval does not include unity.
** = p value is less than or equal to .005, and the 95% confidence interval does not include unity.
+ = inaccurate statistic as a cell value is less than 5
TABLE 13: RESULTS OF THE LOGISTIC REGRESSION COMPARING THE ODDS RATIOS OF THE VARIABLES FOUND TO BE RELATED TO THE DEVELOPMENT OF NURSING CARIES WITH RESPECT TO CASE STATUS.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Active vs Control</th>
<th>Treated vs Control</th>
<th>Total vs Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.73</td>
<td>1.35</td>
<td>-1.50</td>
</tr>
<tr>
<td>Low Dental</td>
<td>4.92</td>
<td>NS</td>
<td>2.71</td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Sources of Information</td>
<td>2.55</td>
<td>NS</td>
<td>2.00</td>
</tr>
<tr>
<td>Father’s Lack of Dental Service Use</td>
<td>3.81</td>
<td>3.51</td>
<td>2.83</td>
</tr>
<tr>
<td>Lack of Workplace Dental Insurance</td>
<td>NS</td>
<td>0.32</td>
<td>NS</td>
</tr>
</tbody>
</table>

-2 Log Likelihood: 131.6 97.2 176.2

Degrees of Freedom: 113 93 135

Significance Level: 0.11 0.36 0.01

Accuracy (%): 70.1 77.1 63.3

NS: The variable was not included in the final equation of the logistic regression.
FIGURE 1

THE DISTRIBUTION OF C.I.N.O.T. CLAIMS, FOR CITY OF NORTH YORK CHILDREN, BY DATE OF BIRTH

Number of Claims by Date of Birth

Number

0 500 1000 1500 2000 2500 3000 3500

89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72

Date of Birth
FIGURE 3
THE AVERAGE COST OF C.I.N.O.T. CLAIMS FOR CITY OF NORTH YORK CHILDREN, BY DATE OF BIRTH

CLAIMS

by Date of Birth

Average Cost (in Hundreds)

DATE OF BIRTH

89 88 87 86 85 84 83 82 81 80 79 78 77 76 75 74 73 72

0 200 400 600 800 1000 1200
FIGURE 3
MAP OF THE CITY OF NORTH YORK SHOWING THE HEALTH PLANNING AREAS
FIGURE 4:

RESULTS FROM THE 1993 PILOT STUDY COMPARED WITH 1992 DATA ON REPORTABLE CHILDHOOD ILLNESSES.

Prevalence of Reportable Childhood Illnesses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measles</td>
<td>3</td>
</tr>
<tr>
<td>Mumps</td>
<td>4</td>
</tr>
<tr>
<td>Pertussis</td>
<td>25</td>
</tr>
<tr>
<td>Chicken Pox</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Total Prevalence 2.0%

Prevalence of Nursing Caries in North York 5.9%

SOURCE: Information regarding the prevalence of the reportable infectious diseases was obtained from the North York Department of Public Health.
FIGURE 5:

ATTRIBUTABLE RISK CALCULATION

\[ \text{AR} = \frac{(RR-1) \times 100}{RR} \]

1) The AR calculation for Active Cases

\[ \text{AR} = \frac{(4.92-1) \times 100}{4.92} = 79.7\% \]

2) The AR calculation for Total Cases

\[ \text{AR} = \frac{(2.71-1) \times 100}{2.71} = 63.1\% \]

The attributable risk per cent is 79.7 per cent in the active cases and 63.1 per cent for total case group.

Population Attributable Risk Calculation

\[ \text{PAR} = (\text{AR})(P_e) \]

\[ \text{PAR} = (63.1)(.17) = 10.7 \text{ per cent.} \]
Dear Parent,

The Community Dental Health Research Unit at the University of Toronto Faculty of Dentistry, and the North York Public Health Department is conducting a study to examine the risk factors associated with the development of cavities in young children. The information obtained from this study will be used to plan better preventive dental programmes in North York.

As you know, your child recently received a dental screening examination by the North York Public Health Department. Your child's name was chosen, from the list of children screened, to participate in this study. She/he may or may not have cavities.

Your participation in this study is completely voluntary. We are asking you to complete the enclosed questionnaire and return it to us in the enclosed stamped addressed envelope. You may choose not to answer some of the questions. All results will be kept strictly confidential, and only group statistics will be reported on. Your family name, or other personal information will not appear at all on the documents that you return to us.

Please be aware that there are no correct answers and that it is your experiences that we are interested in.

If you choose not to participate please complete the last page of the questionnaire, and return it in the envelope provided. By returning this the investigators will know not to contact you again. If you choose not to participate your child will still be eligible for all of the usual services from the North York Public Health Department.

If you have any questions regarding this study please contact Dr. Patricia Abbey at 979-4908 ext 4139.

Thank you for considering our request.

Sincerely,

Dr. P.L. Abbey, and Dr. J.L. Leake
If you do not read English, please find a.multilingual

INFORMATION

Health Department

advisory on health and safety issues.

You may also find the health information on the Department's website at

http://www.northork.ca/health/

You can also contact us by phone at 416-493-1005.

Health Department

You can also contact us by phone at 416-493-1005.

INFORMATION

Health Department

You can also contact us by phone at 416-493-1005.

INFORMATION

Health Department

You can also contact us by phone at 416-493-1005.
ORAL HEALTH SURVEY FOR PARENTS
WITH CHILDREN ATTENDING KINDERGARTEN
IN NORTH YORK
Identification Code

Unless otherwise instructed, please circle the one most appropriate response for each question.

Child's Dental History

1. What is this child's date of birth?
   __/__/____
dd mm yr

2. At what age did you notice your child's teeth begin to grow?
   __________ months

3. Did your child have teething problems?
   1. No
   2. Yes

4. If Yes, did you routinely use soothing medications, for example Tempra or Oragel?
   1. No
   2. Yes

5. Are your child's teeth usually cleaned with a toothbrush and toothpaste?
   1. No (If No, please skip to #9)
   2. Yes
6. At what age did you start to brush your child’s teeth?

_____ months
or
_____ years

7. When are your child’s teeth usually brushed?
(You may circle more than one answer)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>After meals</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Before bed</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

8. Who usually brushes the child’s teeth? (Please circle one answer)

1. Mother
2. Father
3. Child
4. Other (please specify) ____________

9. Do you think your child has cavities?

1. No
2. Yes
3. Don’t Know

10. Does your child have cavities in the front teeth now?

1. No
2. Yes
3. Don’t Know
11. If Yes, how old was the child when you noticed cavities in the front teeth?

_______ months
or
_______ years

12. Have any of your other children had cavities in their baby teeth?

1 No
2 Yes

13. Do you have a family dentist?

1 No
2 Yes
3 Don't Know

14. Has this child ever been to a dentist?

1 No (If No, go to question # 19)
2 Yes
3 Don't Know

15. If Yes, what was the reason for the child's first dental visit?

1 Regular check-up,
2 Pain from a tooth,
3 Concern about the appearance of the teeth,
4 Other (please specify) ____________

16. Have you ever been told by a dentist that this child has or had nursing bottle cavities or baby bottle tooth decay?

1 No
2 Yes
3 Don't Know
17. Has this child ever had fillings or extractions of their front teeth because of cavities?

1. No
2. Yes
3. Don’t Know

18. If Yes, how old was the child at the time of treatment?

_____ months
or
_____ years

19. How are your family dental costs paid?

(You may circle more than one answer)

1. Insurance from work,
2. Government assistance,
3. Paid by you with no insurance,
4. Other (please specify)

20. Who in your family went to a dentist in the last year?

(You may circle more than one answer)

1. No one,
2. Mother,
3. Father,
4. This child,
5. Other child in the family,
6. Other (please specify)

21. Do you have some or all of your natural teeth?

1. No
2. Yes
3. Don’t Know
22. Do you think that you will keep your own natural teeth past the age of 65 years?

1. No
2. Yes
3. Don't Know

---

Child's Medical History

---

23. What was this child's birthweight?

____ lb.____ oz.

or

________ grams

24. Was this child premature? (less than 37 weeks of pregnancy)

1. No
2. Yes
3. Don't Know

---

25. Has this child taken medications for any conditions, for more than one week? For example, antibiotics for ear infections.

1. No
2. Yes
3. Don't Know
26. Have you ever been told that this child has lactose intolerance?

1 No
2 Yes
3 Don't Know

27. After having milk products does your child experience bloating from gas or diarrhoea?

1 No
2 Yes
3 Don't Know

---

**Child's Feeding History**

---

28. Did you ever breast feed this child?

1 No (If No, go to question #32)
2 Yes

29. Other than for meals, did you breast feed this child?

1 No
2 Yes

30. If Yes, when did you do this, and how often?

(You may circle more than one answer)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nap time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bed time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Child crying</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
31. At what age did you wean this child from the breast?

_______ months

or

_______ years

32. Did you ever bottle feed this child?

1  No ( If No, go to question #38 )
2  Yes

33. At what age did you start bottle feeding this child?

_______ months

or

_______ years

34. Did you ever give this child a bottle in the crib?

1  No
2  Yes
3  Don't Know

35. If Yes, when did you do this, and how often?
( You may circle more than one answer )

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nap time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bed time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Child crying</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
36. What did you put in the bottle?
   (You may circle more than one answer)
   1. Breast milk,
   2. Cow's milk,
   3. Formula,
   4. Plain Water,
   5. Sweetened Water,
   6. Juice,
   7. Other (please specify) ————

37. At what age did you stop giving this child a bottle?
   ———— months
   ———— years
   or—

38. Did this child use a sweetened soother, for example with honey?
   1. No (If No, go to question #40)
   2. Yes
   3. Don't Know

39. If Yes, when did your child use the sweetened soother?
   (You may circle more than one answer)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nap time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Bed time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Child crying</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
40. How many times does your child have food or drink (other than water) between meals? (Please circle only one answer)

1. Never (If Never, go to question #43)
2. 1 time per day.
3. 2 times per day.
4. 3 times per day.
5. 4 or more times per day.

41. What is your child's most frequent type of snack?

________________________ (Please specify)

42. Who most often chooses the type of snack, and time for snacking?
(Please circle the one most appropriate answer)

1. The child.
2. Mother.
3. Father.
5. The daycare operator.

43. How many times do you eat or drink (excluding water) between meals?
(Please circle only one answer)

1. Never.
2. 1 time per day.
3. 2 times per day.
4. 3 times per day.
5. 4 or more times per day.
44. Which of the following things do you think may be potentially harmful to a child's teeth? (You may circle more than one answer)

1. Going to sleep with a bottle of milk.
2. Going to sleep with a bottle of juice.
3. Going to sleep with a bottle of sweetened water.
4. Going to sleep with a bottle of water.
5. Going to sleep at the breast.
6. Going to sleep with a sweetened soother.
7. Eating between meals.

Sources of Family Health Information

45. Have you ever been given information from the Public Health Department regarding your child's dental health?

1. No (If No, go to question #47)
2. Yes
3. Don't Know

46. If Yes, how did you receive this information? (You may circle more than one answer)

1. Pre-natal classes from Public Health.
2. Post-natal classes from Public Health.
3. Home visit from a Public Health Nurse.
4. From the school dentist.

47. Did you attend pre-natal classes?

1. No (If No, go to question #51)
2. Yes
3. Don't Know
48. If Yes, were these classes taught by:

1. The hospital where the child was born,
2. The Public Health Department,
3. Other agency (please specify)

49. If Yes to #47, did the classes include information on the prevention of cavities?

1. No
2. Yes
3. Don’t Know

50. Did the class discuss Baby Bottle Tooth Decay?

1. No
2. Yes
3. Don’t Know

51. Who is your primary source of child care information?
( Please circle only one answer )

1. Family members,
2. Friends,
3. The child’s medical doctor,
4. Public Health Nurses,
5. Daycare Centre / school,
6. Other (please specify)

52. Do you have a family doctor or paediatrician that your child sees regularly?

1. No
2. Yes
3. Don’t Know
53. If Yes, has she/he ever given you information regarding your child's teeth?

1  No
2  Yes
3  Don't Know
The North York Health Department needs information about families who will benefit from more preventive dental information. Please complete the following questions about our family.

54. Who completed this questionnaire?
1. Mother,
2. Father,
3. Grandparent,
4. Guardian,
5. Baby-sitter,
6. Other ________

55. Mother's age:
________ years

56. Father's age:
________ years

57. In which country was the child's mother born?


58. In which country was the child's father born?


59. In which country was the child born?


60. If the child was born outside of Canada, in what year did he/she immigrate to Canada?

61. How many people live in your home?

62. In order of birth, is this child the:

1. Oldest,
2. Youngest,
3. In the middle.

63. What is the highest level of school completed by the child’s mother and father?

( Please circle one answer for each parent )

<table>
<thead>
<tr>
<th></th>
<th>Mother</th>
<th>Father</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal schooling</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Some grade school</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Grade school completed</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Some high school</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>High school completed</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Some college, technical school</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>College, technical school completed</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Some university</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>University degree completed</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

64. What was your approximate total household income for the year 1993, before tax deductions?

1. Less than $19,999
2. $20,000 - $39,999
3. $40,000 - $59,999
4. Greater than $60,000
5. Don’t Know
6. Don’t wish to respond

Thank-you for participating in our study.
Identification Code ______

I do not wish to participate in this study. ______

I understand that this will in no way affect the services that my family receives from the North York Department of Public Health.
APPENDIX 2: A COMPARISON OF THE STUDY POPULATION AND GENERAL NORTH YORK POPULATION WITH RESPECT TO SEVERAL DEMOGRAPHIC FACTORS RELATED TO SOCIO-ECONOMIC STATUS.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Study Population</th>
<th>General Population of North York</th>
<th>East Health Planning Area</th>
<th>Central Health Planning Area</th>
<th>West Health Planning Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$19,999</td>
<td>33.8</td>
<td>19.1</td>
<td>15.4</td>
<td>20.2</td>
<td>22.4</td>
</tr>
<tr>
<td>$20 - $39,000</td>
<td>19.8</td>
<td>24.7</td>
<td>23.5</td>
<td>23</td>
<td>28.1</td>
</tr>
<tr>
<td>&gt; $40,000</td>
<td>21.3</td>
<td>56.3</td>
<td>61.2</td>
<td>56.9</td>
<td>49.6</td>
</tr>
<tr>
<td>*DK, **DNWTR, ***MV Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; Grade 9</td>
<td>7.5</td>
<td>13.8</td>
<td>7.2</td>
<td>12</td>
<td>23.1</td>
</tr>
<tr>
<td>Highschool, part/complete College</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.9</td>
<td>32.7</td>
<td>36.4</td>
<td>34.5</td>
<td>33.8</td>
<td>41.8</td>
</tr>
<tr>
<td>Trade, Some University Completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.5</td>
<td>17.2</td>
<td>22.1</td>
<td>21.3</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>University ***MV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of Origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Immigrant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child: 79</td>
<td>53.5</td>
<td>55.4</td>
<td>56.6</td>
<td>48.8</td>
<td></td>
</tr>
<tr>
<td>Mother: 28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father: 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (&lt;2500gm)</td>
<td>7.1</td>
<td>6.1</td>
<td>6.0</td>
<td>5.4</td>
<td>6.8</td>
</tr>
<tr>
<td>Breast Feeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiated</td>
<td>71</td>
<td>87</td>
<td>94.2</td>
<td>90.6</td>
<td>79.2</td>
</tr>
</tbody>
</table>

* DK, Don’t Know  
** DNWTR, Does Not Wish To Respond  
*** MV: Missing Value
APPENDIX 3:  ILLUSTRATION OF THE RESPONSE TO THE THREE STAGE MAIL-OUT OF THE QUESTIONNAIRE.

281 POSSIBLE CASES

347 POSSIBLE CONTROLS

202 First Mail-out

274 First Mail-out

195 Second Mail-out

264 Second Mail-out

157 Third Mail-out

239 Third Mail-out

Total Returned

124 Cases

108 Controls

16 Refused

6 Unusable

8 Non-cases

3 Refused

TOTAL SAMPLE

100 CASES

107 CONTROLS
APPENDIX 4: MINIMUM SAMPLE SIZE BASED ON THE ODDS RATIOS AND PREVALENCE OF THE EIGHT VARIABLES FOUND TO STATISTICALLY SIGNIFICANT IN THE RISK ANALYSIS.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minimum Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
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